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Toxic and Hazardous
Materials Agency

MASTER ENVIRONMENTAL PLAN

JEFFERSON PROVING GROUND
MADISON, INDIANA

November 1990

prepared for

Commander

U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland 21010-5401

prepared by

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MASTER ENVIRONMENTAL PLAN FOR JEFFERSON PROVING GROUND

SUMMARY

This Master Environmental Plan (MEP) describes, in detail, the existing conditions of forty-six (46) solid waste management units (SWMUs) and areas requiring environmental evaluation (AREEs), additional data that is required, and proposed activities at Jefferson Proving Ground (JPG) in Madison, Indiana. This plan was developed to comply with the solid and hazardous waste rules, water and air quality rules of the state of Indiana. The recommendations in this MEP also comply with the Base Closure Act, and federal regulations as stated in the Hazardous and Solid Waste Amendments of 1984 and the Superfund Amendments Reauthorization Act of 1986.

This report describes the environmental setting of the study area, defines regulatory considerations, and presents assessments of and proposed actions for each of the 46 sites.

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LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|-----------------|--|
| AEHA | Army Environmental Hygiene Agency |
| Ag | Silver |
| AMC | Army Materiel Command |
| ANL | Argonne National Laboratory |
| AREEs | areas requiring environmental evaluation |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| As | arsenic |
| Ba | barium |
| bls | below land surface |
| BTEX | benzene, toluene, ethylbenzene, xylene |
| CAA | Clean Air Act |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| Cd | cadmium |
| CFR | Code of Federal Regulations |
| CO | carbon monoxide |
| CO ₂ | carbon dioxide |
| Cr | chromium |
| CS/CN | riot control agent |
| CWA | Clean Water Act |
| DNT | dinitrotoluene |
| DEM | Department of Environmental Management |
| DO | dissolved oxygen |
| DOD | Department of Defense |
| DOE | Department of Energy |
| DRMO | Defense Reutilization and Marketing Office |
| DU | depleted uranium |
| EO | Explosive Ordnance |
| EOD | Explosive Ordnance Disposal |
| °F | degrees Fahrenheit |
| FR | Federal Register |
| ft. | foot, feet |
| HE | high explosive |
| Hg | mercury |
| HMX | 1,3,5,7-tetranitro-1,3,5,7 -tetraazacyclooctane |
| HNS | hexanitrostibene |
| HSWA | Hazardous and Solid Waste Amendment |
| HVAC | heating, ventilation, and air conditioning |
| IAC | Indiana Administrative Code |
| JPG | Jefferson Proving Ground |
| kg | kilograms |
| MCLs | Maximum Contaminant Levels |
| MCLGs | Maximum Contaminant Level Goals |
| mg/l | milligrams/liter |
| MPRSA | Marine Protection Research and Sanctuaries Act |
| MW | monitoring well |

LIST OF ACRONYMS AND ABBREVIATIONS (Cont'd.)

| | |
|----------|--|
| NPL | National Priorities List |
| Pb | lead |
| PCBs | polychlorinated biphenyls |
| POL | petroleum, oil, and lubricants |
| ppm | parts per million |
| RCRA | Resource Conservation and Recovery Act |
| RDX | cyclotrimethylene trinitramine |
| RI | remedial investigation |
| SARA | Superfund Amendments and Reauthorization Act |
| Se | Selenium |
| SDWA | Safe Drinking Water Act |
| SQG | Small Quantity Generator |
| SWMUs | solid waste management units |
| TECOM | U.S. Army Test and Evaluation Command |
| TCA | trichloroethane |
| TCE | trichlorethylene |
| TCL | Target Compound List |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TNG | trinitroglycerol |
| TNT | trinitrotoluene |
| TPH | total petroleum hydrocarbons |
| TSCA | Toxic Substances Control Act |
| µg/g | micrograms/gram |
| µg/l | micrograms/liter |
| USATHAMA | U.S. Army Toxic and Hazardous Materials Agency |
| USEPA | U.S. Environmental Protection Agency |
| USTs | underground storage tanks |
| UXO | unexploded ordnance |
| VOCs | volatile organic compounds |

1.0 INTRODUCTION

Jefferson Proving Ground (JPG) occupies 55,265 acres of land along U.S. Highway 421, north of the city of Madison, Indiana. Portions of JPG are located in Ripley, Jennings, and Jefferson Counties. The installation is approximately eighteen (18) miles long (north-south) and five (5) miles wide (east-west). Most of JPG is wooded, with clear areas surrounding the building complexes and airport. The non-wooded areas north of the firing line are located at high impact target areas. The topography of JPG is flat to rolling, with most relief due to stream incision. Surface water drainage is generally from the northeast to the southwest, and consists of seven streams and their tributaries.

JPG is a test center of the U.S. Army Test and Evaluation Command (TECOM). The mission of JPG is to plan and conduct production acceptance tests, reconditioning tests, surveillance tests, and other studies of ammunition and weapons systems (including system components). The buildings, roadways, and fixtures have been built to meet the requirements of the primary mission of JPG. To this end, there are 268 gun positions, 50 impact fields, 13 permanent test complexes and seven ammunition assembly plants.

JPG has been used as a testing ground for ammunition since its purchase in 1940. A wide assortment of munitions and ordnance have been tested at JPG, including propellants, mines, ammunition,

cartridge cases, artillery projectiles, mortar rounds, grenades, tank ammunition, bombs, boosters, and rockets.

Past and present activities at JPG have resulted in the detonation, burning and disposal of many types of waste propellants, explosives and pyrotechnic substances at the site. Physically hazardous materials consist mainly of explosive ordnance (EO), which is spread over most of the area north of the firing line and portions south of the firing line. The hazardous wastes consist of explosives (e.g. trinitrotoluene -TNT), waste propellants, lead, chlorinated solvents, wood preservatives, sulfur, silver, photographic development wastes, sanitary wastes, and petroleum products. Some of these wastes are known to have been released into the soil, with subsequent migration into ground water, and others are suspected of migrating into ground and surface waters. The past and present environmental assessment programs have not included extensive sampling and analyses of soils and/or water. Most studies have been very limited in scope, dealing with a small area of the facility, or with a particular solid waste management unit (SWMU).

1.1 OBJECTIVE

This MEP follows an enhanced preliminary assessment, which was conducted by Ebasco through Argonne National Laboratory (ANL) for the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). A

summary of Ebasco's Enhanced Preliminary Assessment is included in Appendix I. The impetus for the MEP is the Base Closure Act of 1988, which mandated that eighty six U.S. military bases close; Jefferson Proving Ground is on the list slated for closure.

This MEP has the objectives of: 1) defining field activities which will provide the additional information required to characterize the areas of concern at JPG; 2) supporting the Installation Restoration Program activities; 3) providing information which may be used to prioritize site actions, and; 4) assisting in the development of cost-effective response actions.

2.0 DESCRIPTION OF JEFFERSON PROVING GROUND

Jefferson Proving Ground is a test center for U.S. Army Test and Evaluation Command (TECOM). TECOM is a major subordinate Command of Army Materiel Command (AMC). The mission of JPG is to plan and conduct production acceptance tests, reconditioning tests, surveillance tests, and other studies of ammunition and weapons systems (including components of the systems).

JPG was designed and built as a test range for testing conventional ordnance. The main firing line is in the southern part of the facility, and runs east-west for five miles. Most of JPG is wooded, with clear areas surrounding the building complexes and airport south of the firing line. The high impact target areas comprise the non-wooded areas north of the firing line.

The buildings, roadways and fixtures have been built to meet the requirements of the primary mission of JPG. There are 268 gun positions, 50 impact fields, 13 permanent test complexes, and seven ammunition assembly plants.

The impact areas on JPG include high impact targets, asphalt and sediment bottom ponds for testing proximity fuses, a gunnery range at the northern portion of the site, mine fields, and a depleted uranium impact area. Also associated with the impact areas are safety fans (areas where wide, long or short rounds may fall) as

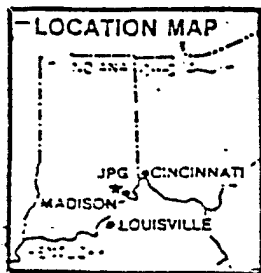
well as observation bunkers, which are used to house personnel who measure range and height of bursts. All of the impact areas and safety fans are considered to be contaminated with explosive ordnance (EO).

2.1 LOCATION AND GEOGRAPHY

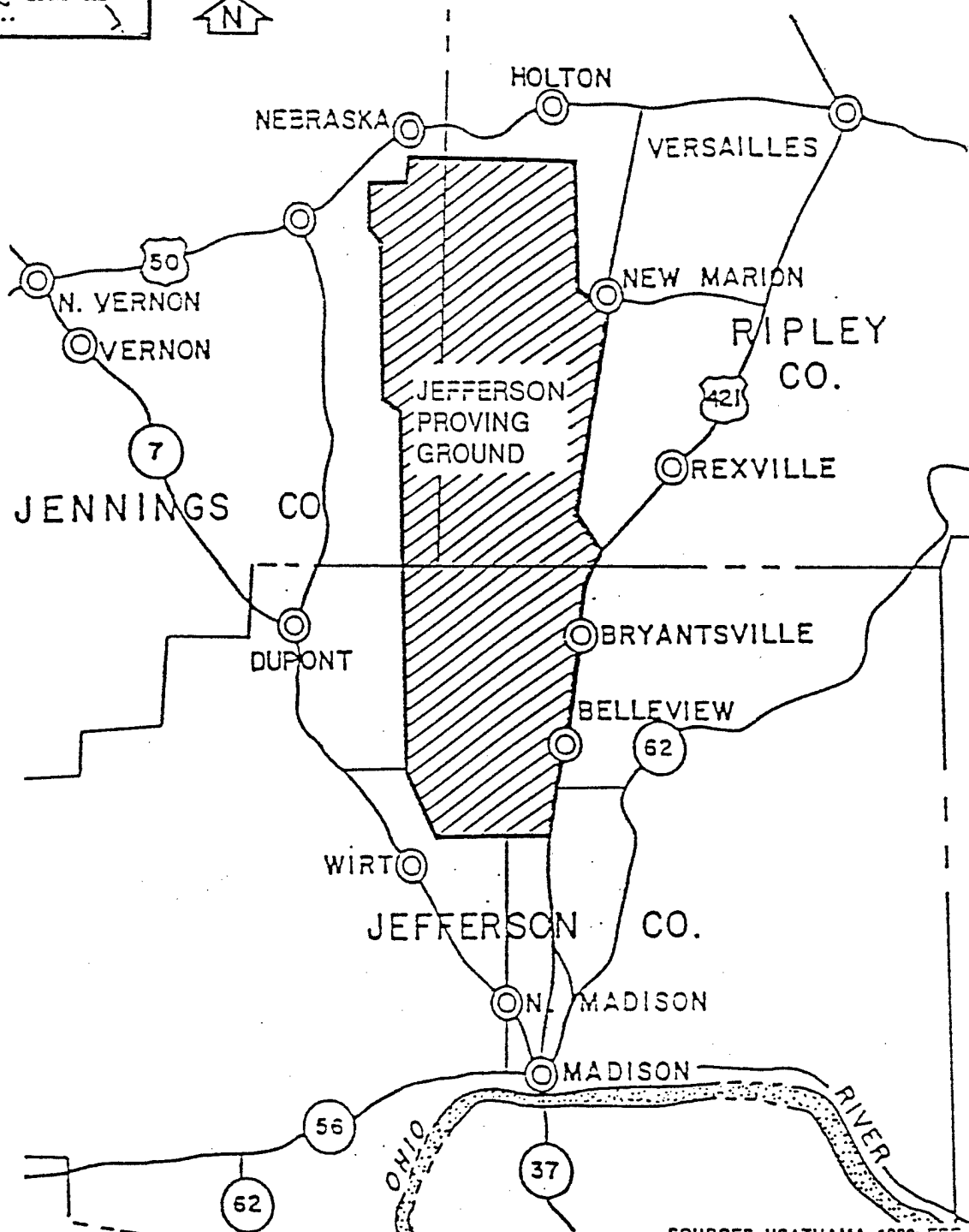
Jefferson Proving Ground occupies 55,265 acres of land along U.S. Highway 421, north of Madison, Indiana (Figure 2.1). The facility is located on U.S. Highway 421 approximately 9 miles north of Madison, Indiana and about 85 miles southeast of Indianapolis, Indiana. Portions of JPG are located in Ripley, Jennings, and Jefferson Counties. The installation is approximately 18 miles long (north-south) and 5 miles wide. The topography of JPG is flat to rolling, with most relief due to stream incision. Surface water drainage is northeast to southwest, and consists of seven streams and their tributaries.

2.2 CLIMATE AND METEOROLOGY

The climate at JPG is mid-continental with frequent changes in temperature and humidity. During the summer, the temperature averages from 77-88°F. On an average, the temperature exceeds 90°F for 39 days a year. In winter the average temperature ranges from 22-35°F. Winter precipitation increases soil moisture and minimizes drought effects during summer. The total annual



SCALE
 5 0 5 10 MILES
 5 0 5 10 KILOMETERS



SOURCES: USATHAMA, 1980; ESE, 1985.

MASTER ENVIRONMENTAL PLAN
 JEFFERSON PROVING GROUND
 MADISON, INDIANA

EBASCO ENVIRONMENTAL

FIGURE 2.1
 Location Map

precipitation is about 42-44 inches. Nearly 50 percent of the precipitation occurs during the growing season. On the average, 28 days of the year have precipitation greater than or equal to 0.5 inch.

2.3 GEOLOGY

Jefferson Proving Ground lies on the western limb of the plunging anticline known as the Cincinnati Arch. JPG is located in the Till Plains section of the Central Lowlands Province; the geology of the area is that of glacial till overlying Ordovician and Silurian bedrock which consists of limestones and dolomites interbedded with shales.

2.3.1 Soils and Unconsolidated Deposits

The unconsolidated materials that form the uplands consist of loess over glacial till of Illinoisan and Wisconsinan Age. The tills are typically 25 to 35 feet thick, but range in thickness from 0 to 50 feet in the upper areas. The tills are not present in and near stream valleys. Most of the upland areas are poorly to moderately drained, resulting in puddle formation following precipitation events.

Soils at JPG have developed from glacially derived parent materials. There are two major soil associations present on the

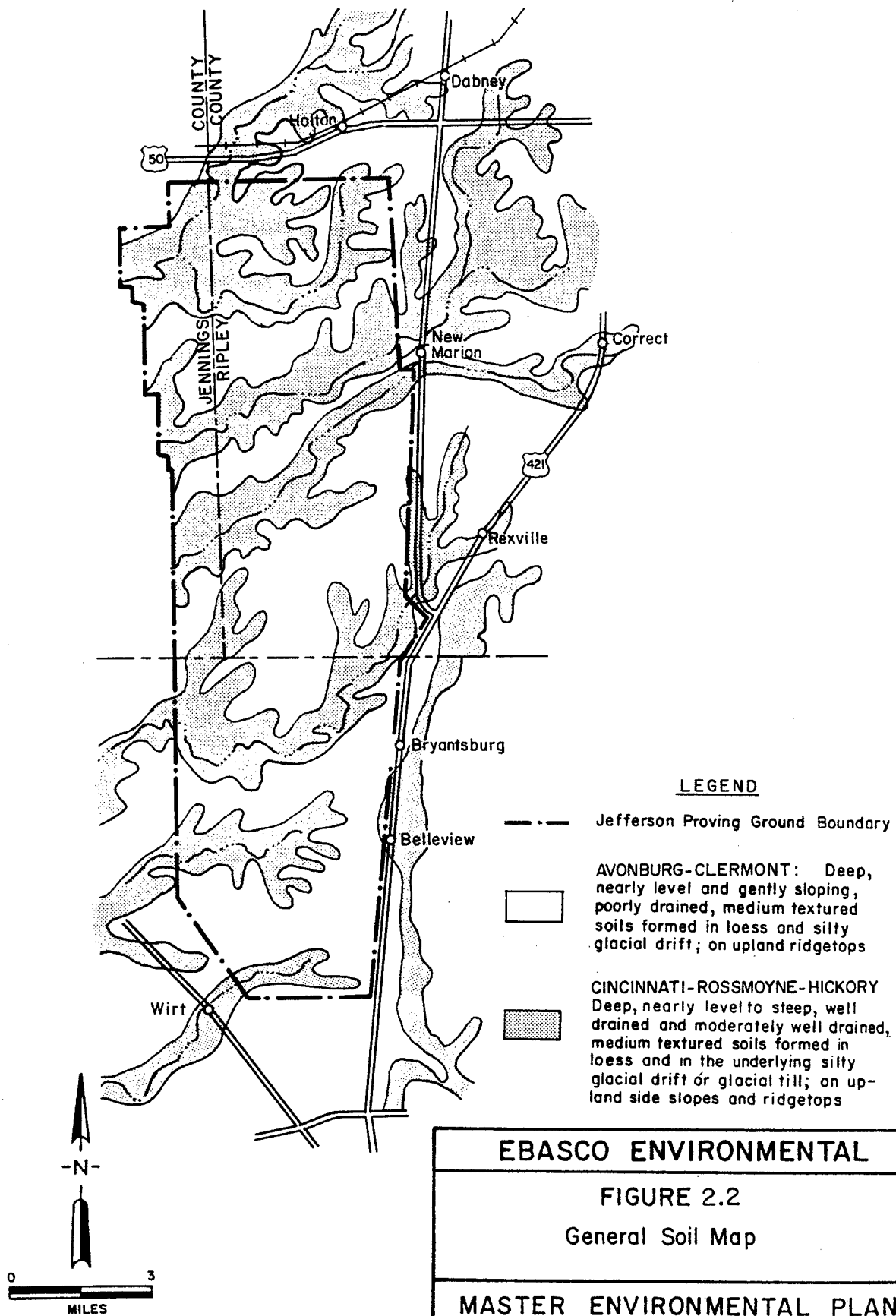
installation; the Cincinnati-Rossmoyne-Hickory and the Avonburg-Clermont (Figure 2.2).

The soils of the Cincinnati-Rossmoyne-Hickory association are generally deep, moderately well drained to well drained, nearly level to moderately steep sloped, formed in loess and underlying loamy glacial till. This association is made up of primarily of nearly level to moderately steep soils on ridgetips, breaks and hillsides. Erosion and runoff are the main hazards in use and management of these soils. The low permeable, firm and brittle layers (fragipan) restrict the downward movement of water.

The soils of the Clermont-Avonburg association are deep, somewhat poorly drained, nearly level and gently sloping soils formed in loess and underlying loamy glacial till. This soil association consists mainly on nearly level and gently sloping soils on broad ridges. Excessive wetness is the main limitation in use and management of these soils. The very slowly permeable, very firm and brittle layers (fragipan) restrict the downward movement of water.

2.3.2 Bedrock

The bedrock in southeastern Indiana was formed in shallow inland seas during the Ordovician and Silurian Ages (approx 500 - 395 million years ago). The bedrock consists of thick sequences of



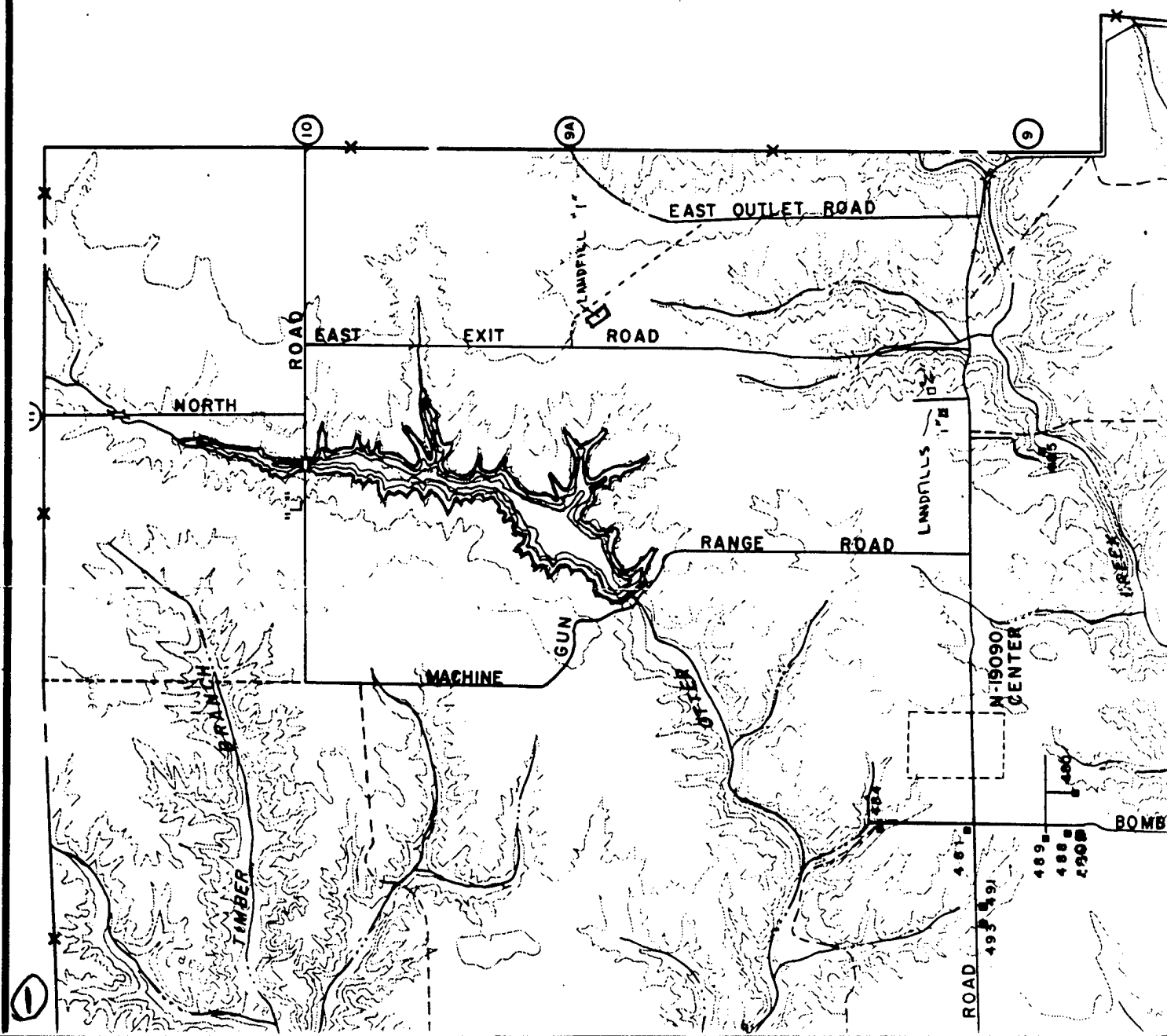
interbedded limestones (or dolomites) and shales. The bedrock in this area makes up a portion of the western limb of the Cincinnati Arch, so it dips slightly to the west. The Dillsboro formation is composed of grey calcareous shale, which contains up to 50% thin limestone beds. The upper Dillsboro outcrops in many channels of the streams that cross JPG. From the outcrops, one can see that the rock is comprised of thin layers of shale and limestone, and that the sequence contains joints and fractures. There do not appear to be any sinkholes at JPG.

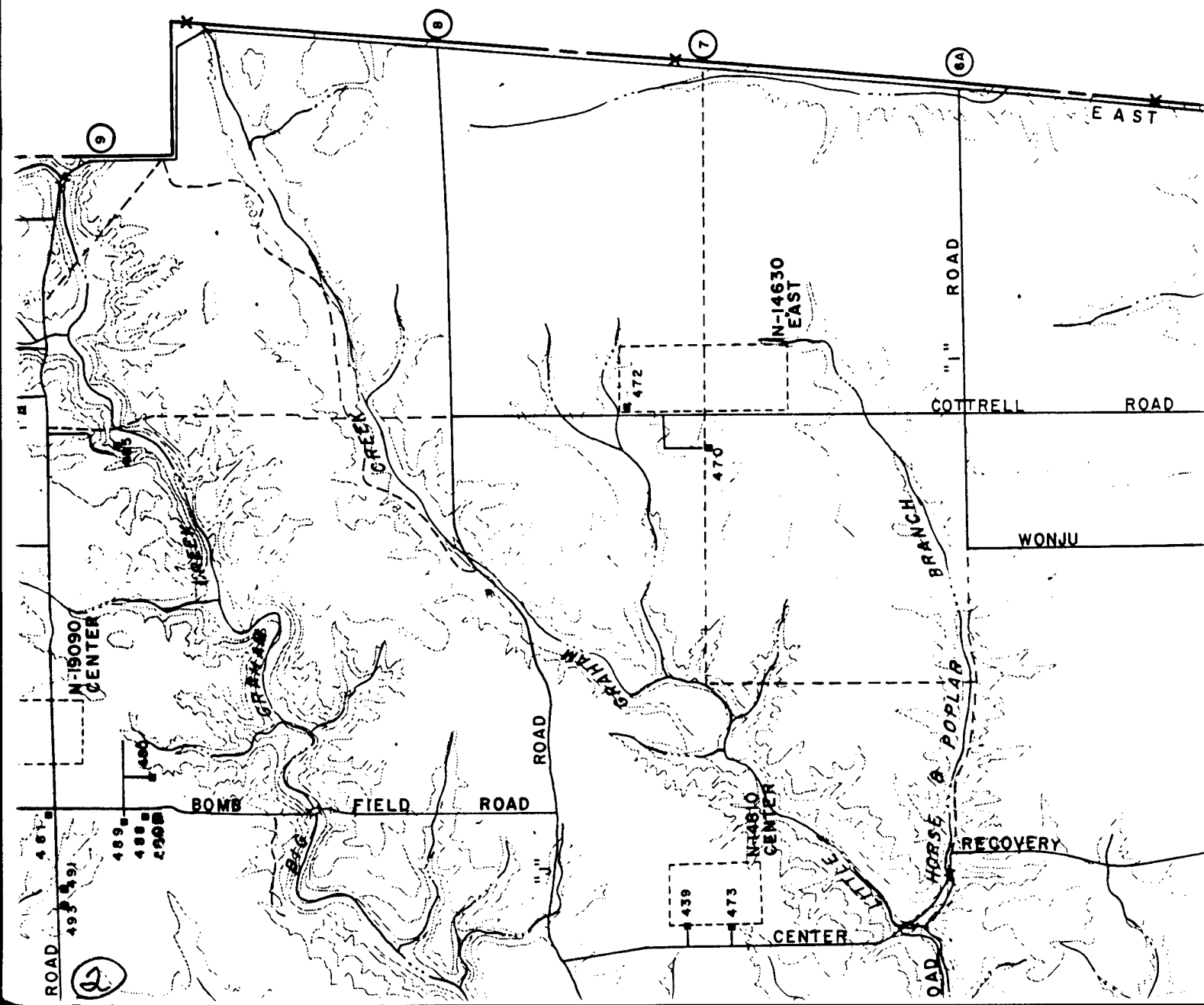
2.4 HYDROLOGY

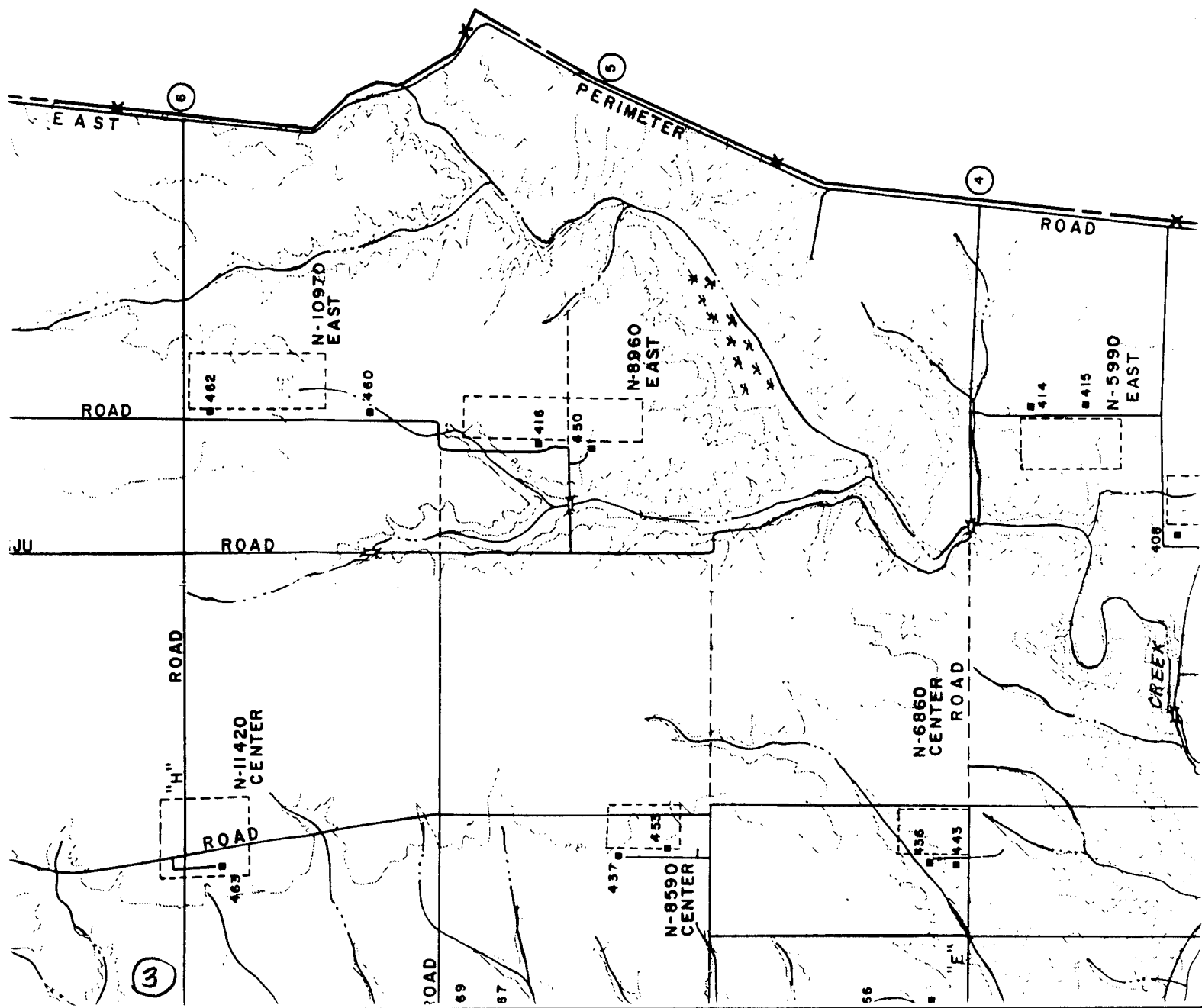
There is very little information regarding the surface and ground water flow and quality at Jefferson Proving Ground. No comprehensive studies of the drainage basins or flow regimes have been undertaken.

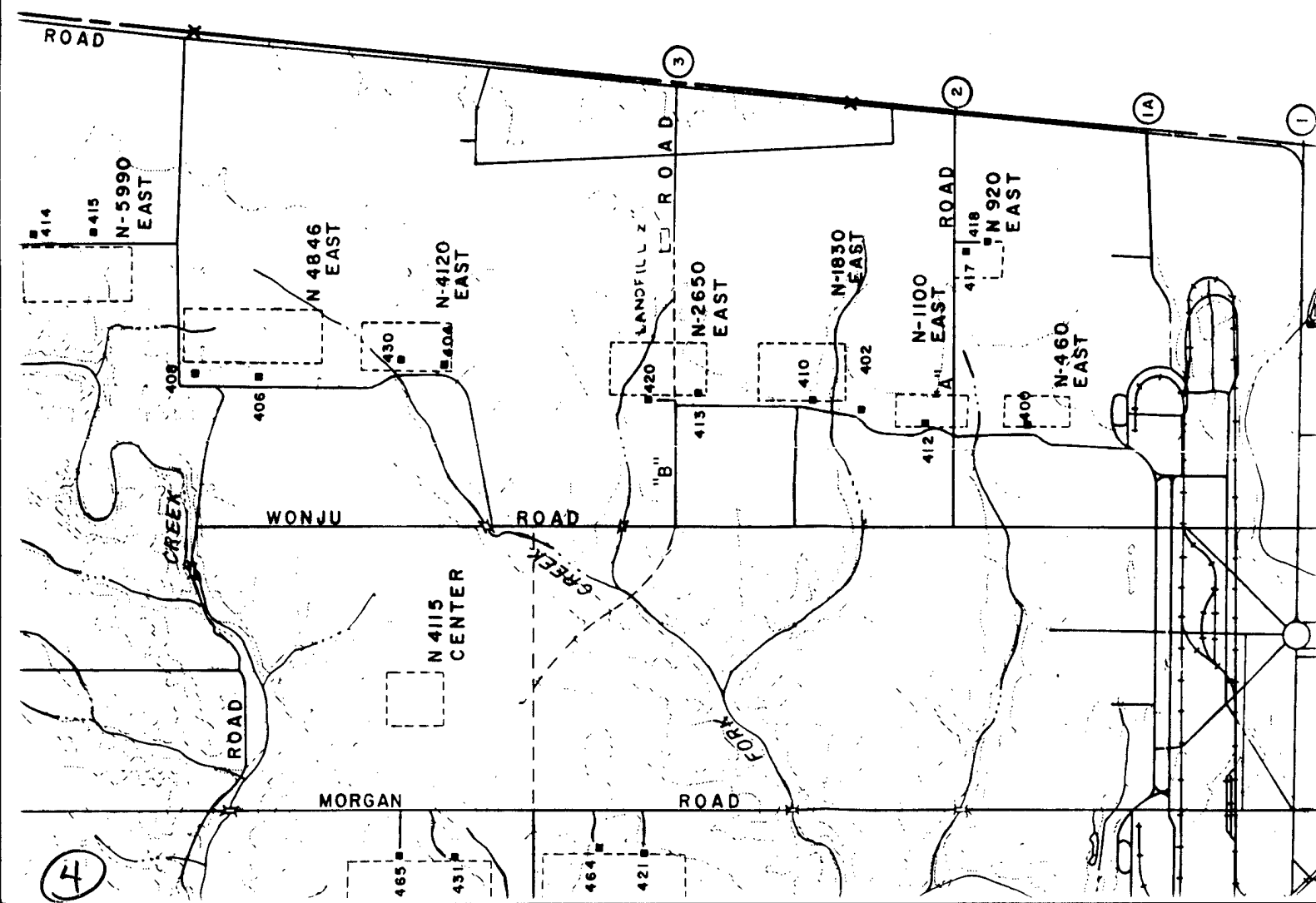
2.4.1 Surface Water

The major creeks and streams on the installation are Otter Creek, Graham Creek, Little Graham Creek, Marble Creek, Big Creek, Middle Fork Creek, and Harberts Creek (Figure 2.3). All the streams flow to the west or south west. Some flooding and flash flooding have infrequently occurred in the past at JPG, but the extent has been small and only minor road repairs were required. Erosion and resultant sedimentation have been limited to down range impact









LEGEND

EXISTING



BUILDINGS, PERMANENT



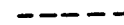
BUILDINGS, SEMIPERMANENT



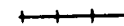
BUILDINGS, TEMPORARY



PAVED AREAS



TRAIL OR EARTH ROAD



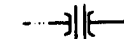
RAILROAD



FENCE



RESERVATION BOUNDARY



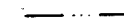
CULVERT



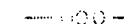
DAM



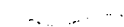
SHORE LINE



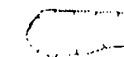
DRAINAGE CHANNEL



INDEX CONTOUR



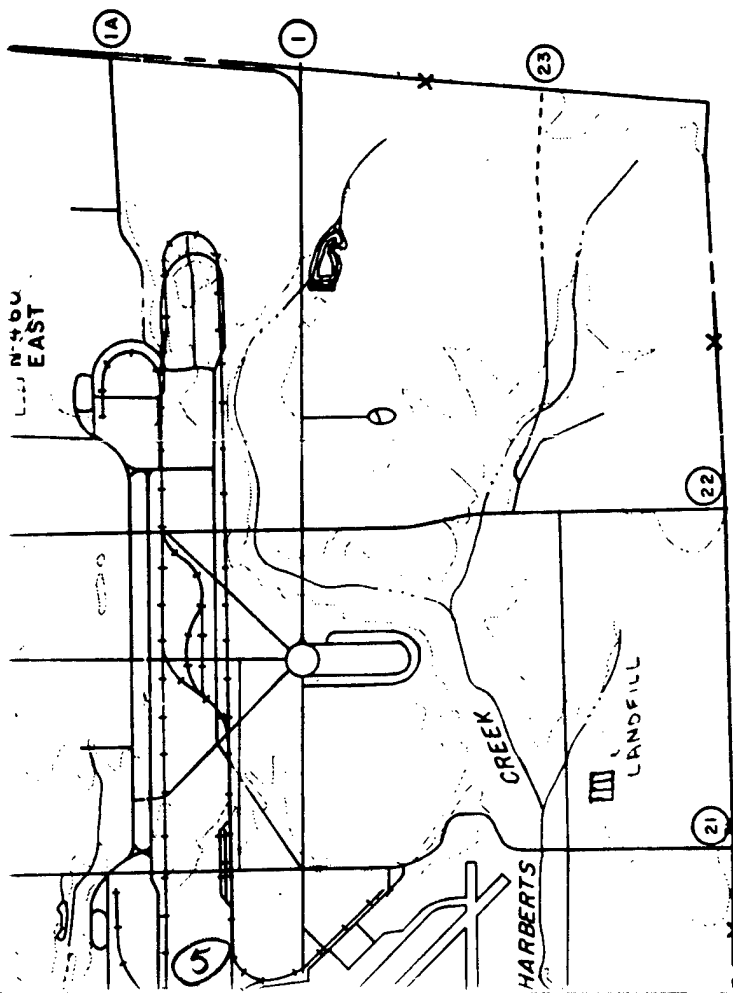
CONTOUR

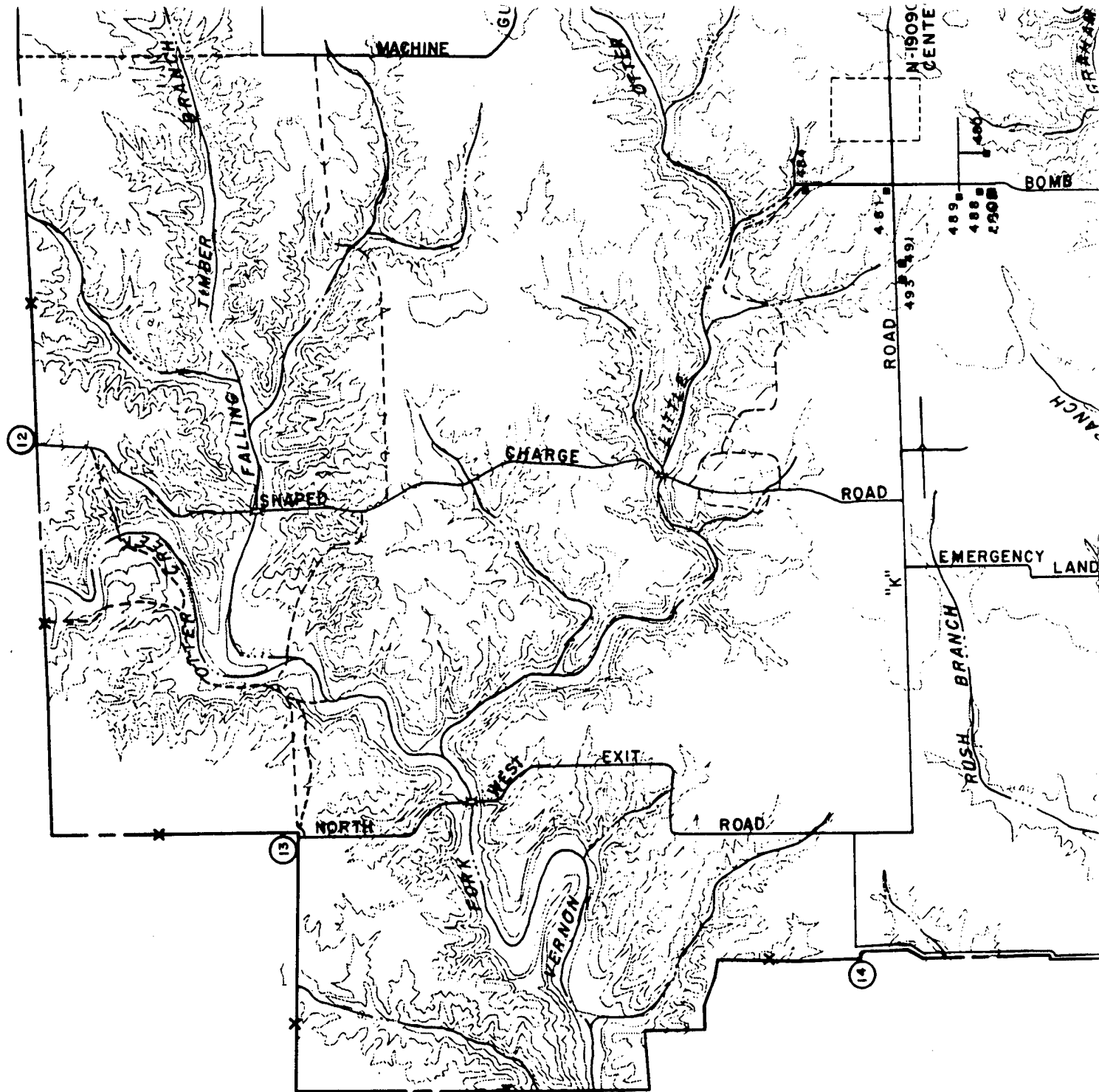


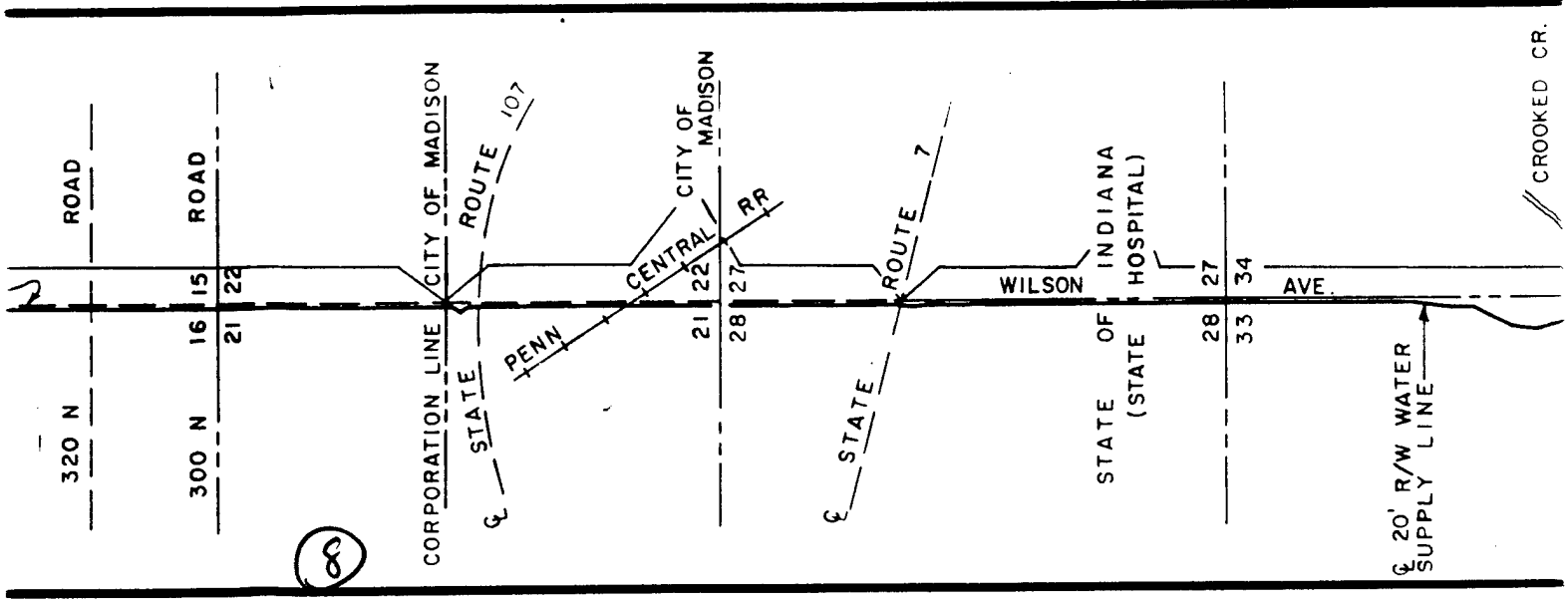
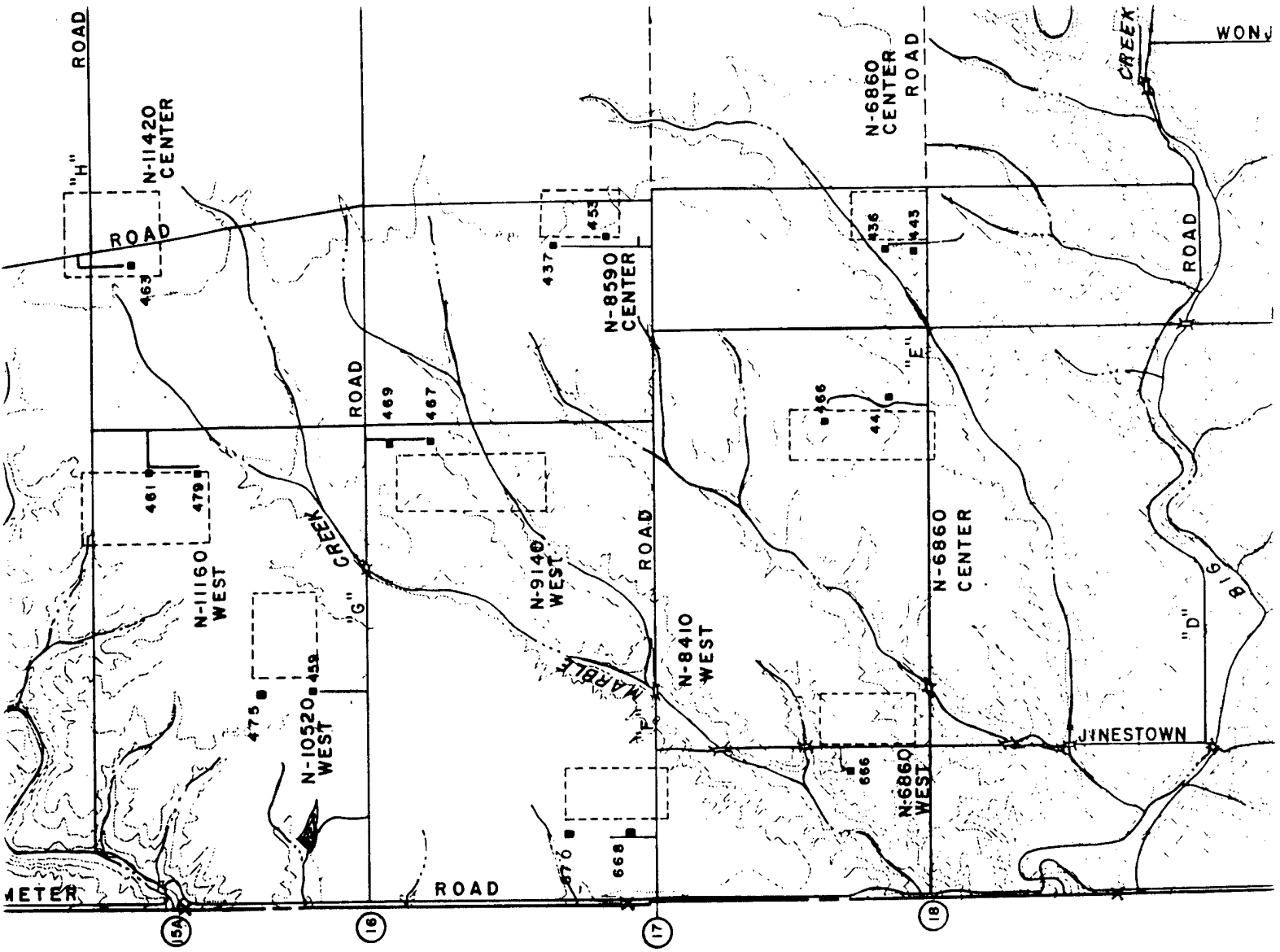
DEPRESSION



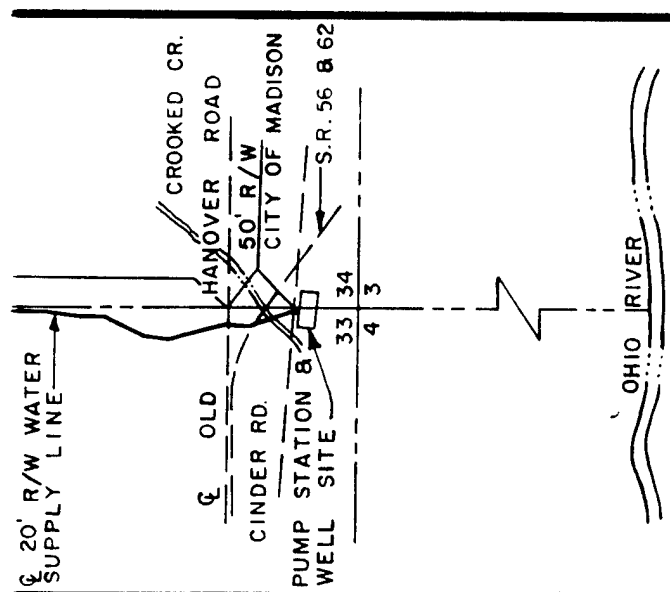
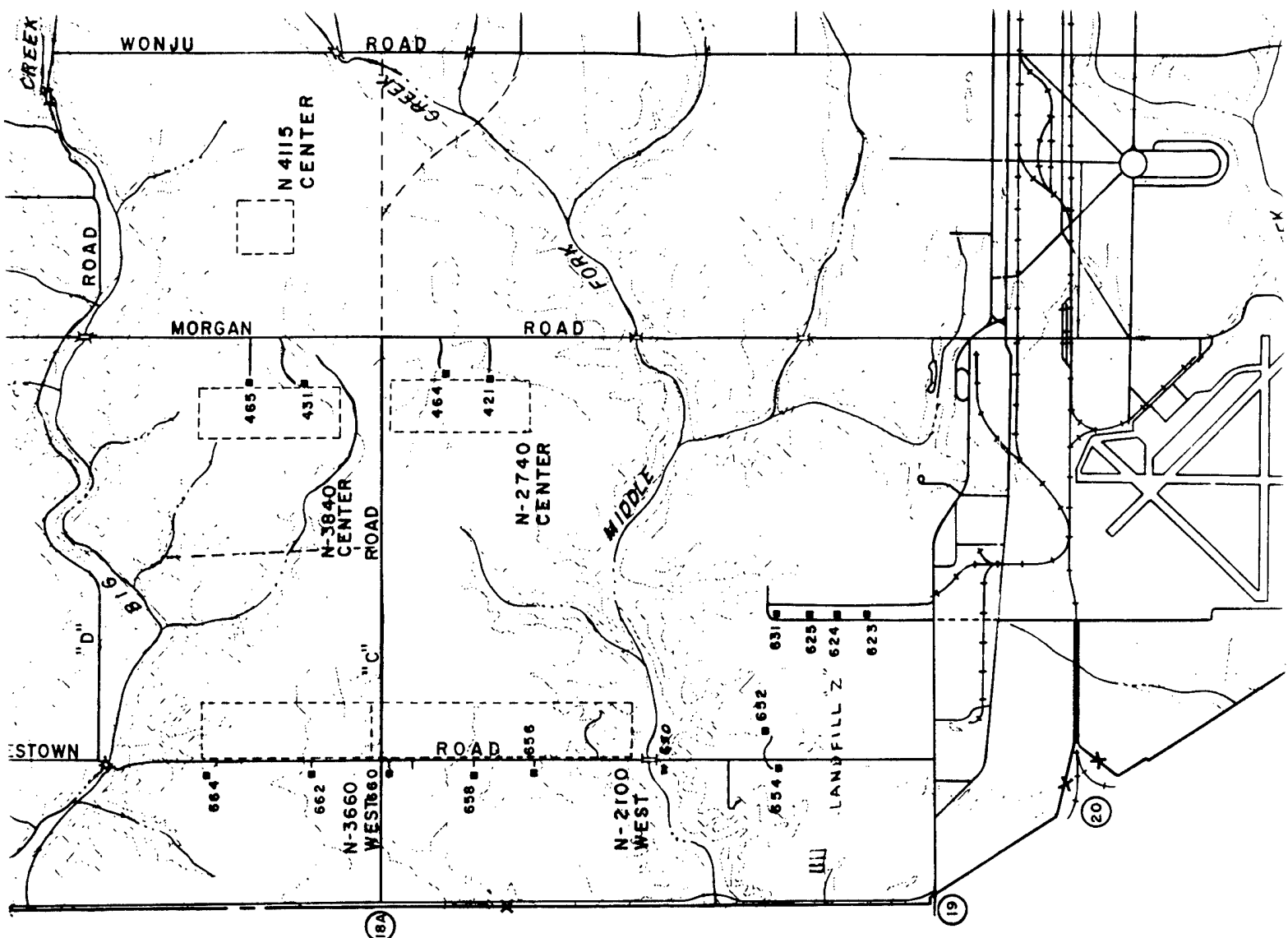
GATE NO.





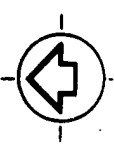


8

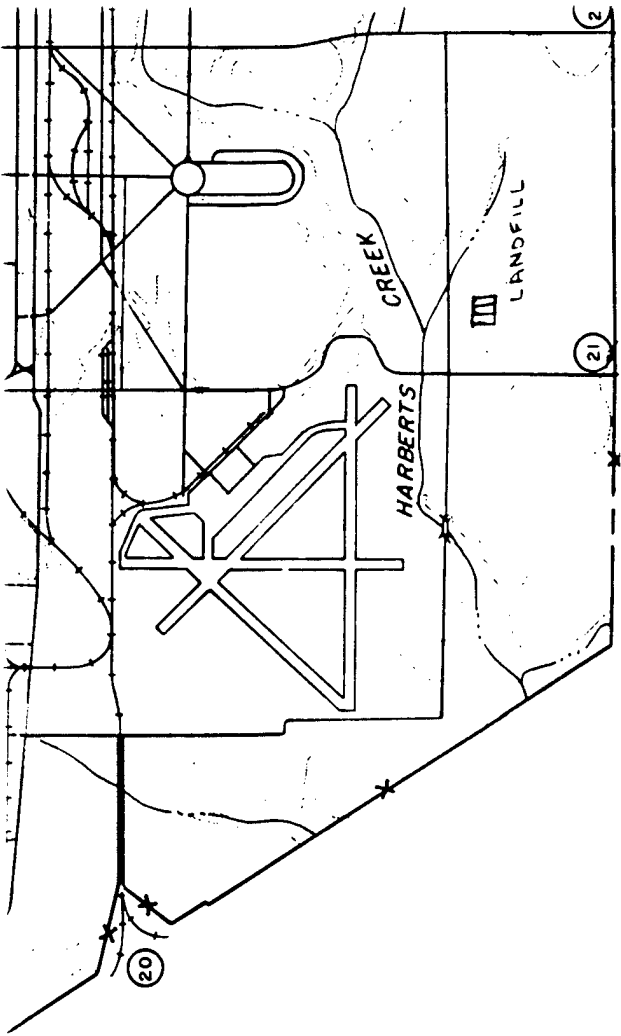


LEGEND

- 20' R/W WATER SUPPLY LINE
- OLD
- CINDER RD.
- PUMP STATION & WELL SITE
- OHIO RIVER
- 9/10 16/15
- RIVER OR CREEK
- RAILROAD
- ROAD



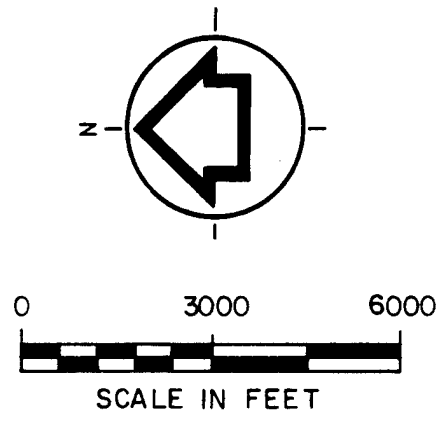
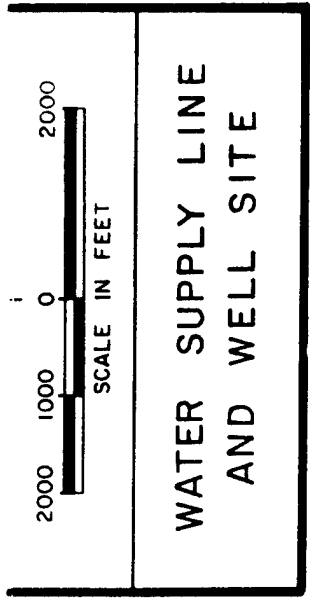
WATER SUPPLY LINE
AND WELL SITE



- 100 — INDEX CONTOUR
- ~ ~ ~ CONTOUR
- DEPRESSION
- ⑫ GATE NO.

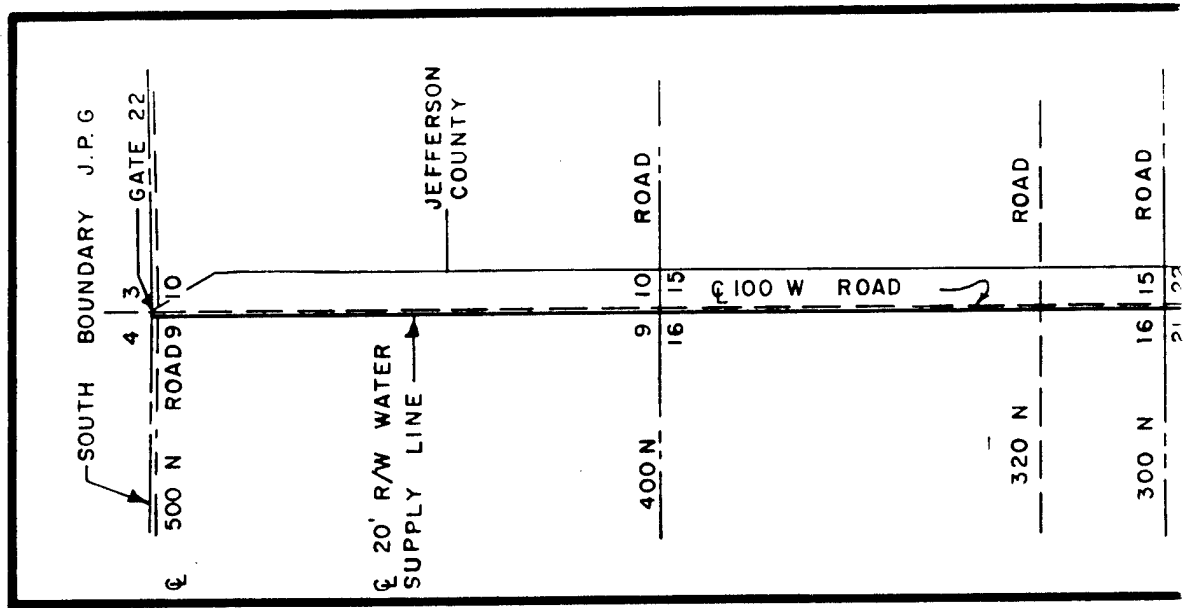
FLOODING IS KNOWN TO HAVE OCCURRED ON ALL MAJOR STREAMS THROUGHOUT J.P.G. - FLOOD OUTLINE, NOT SHOWN DUE TO INSUFFICIENT HEADWATER DATA.

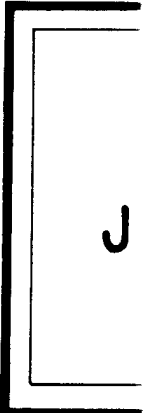
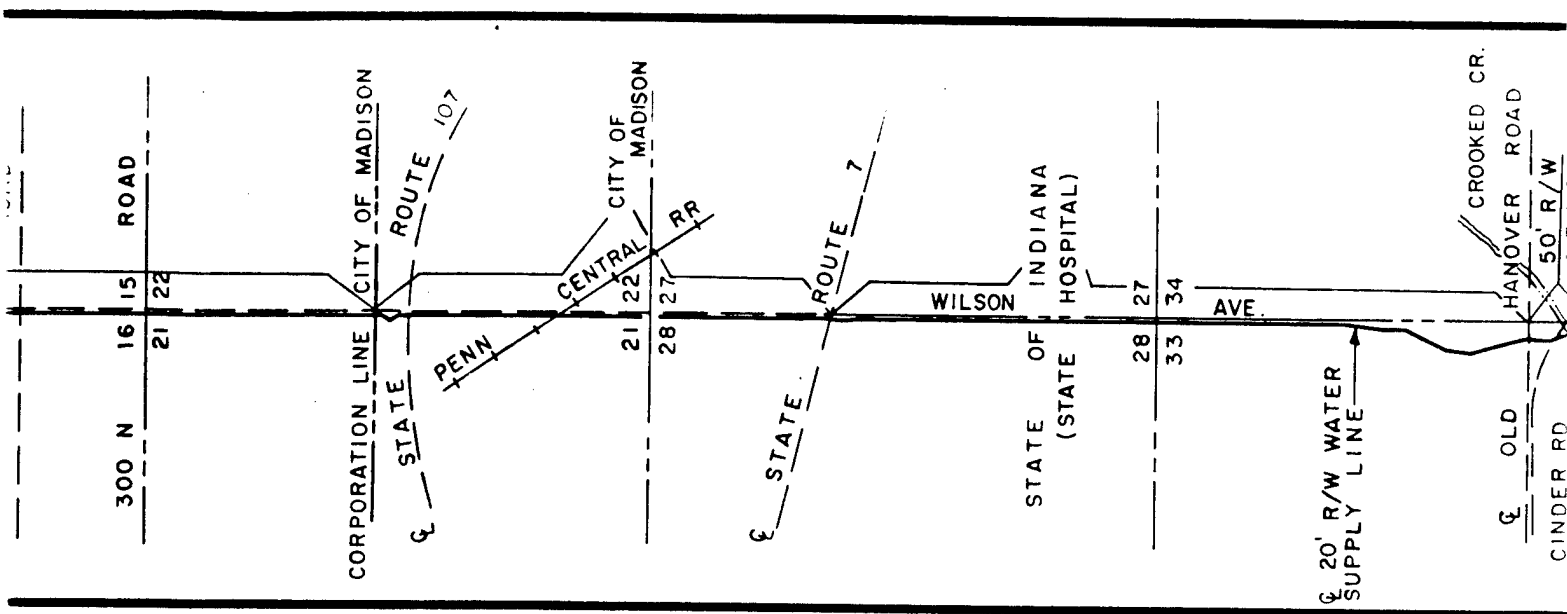
NOTE:
CONTOURS FROM U.S.G.S. TOPOGRAPHIC MAPS,
NOT CORRECTED FOR AS BUILT GRADING.





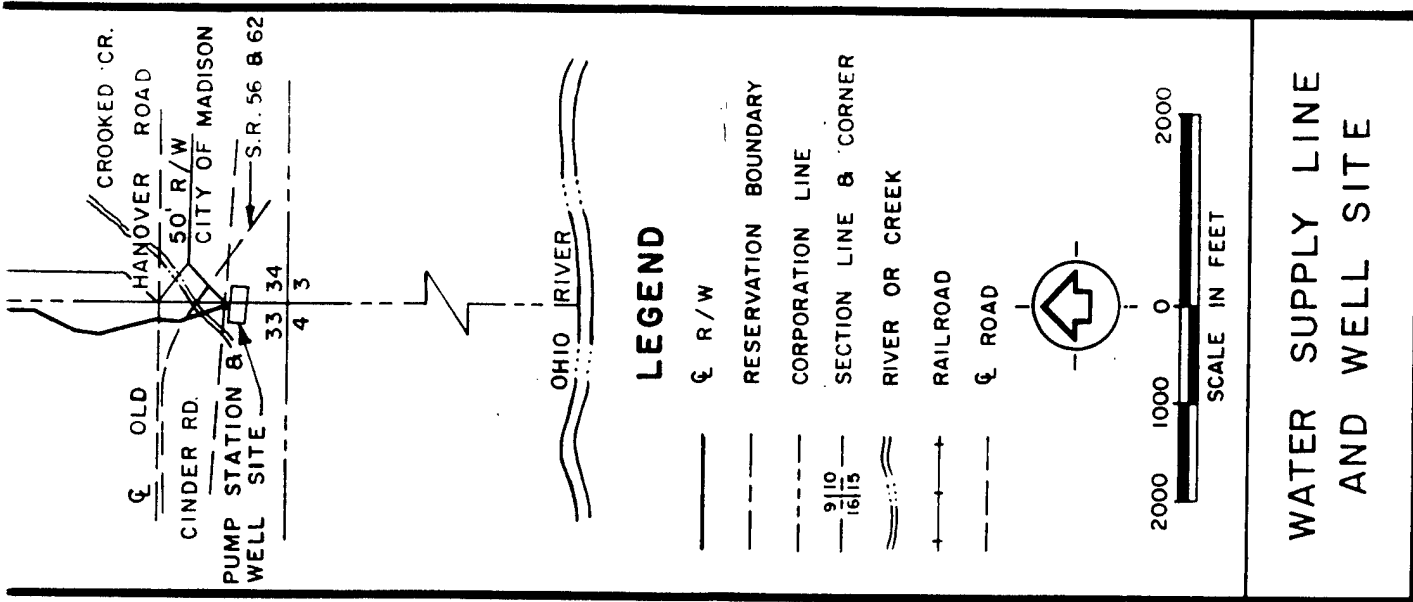
①

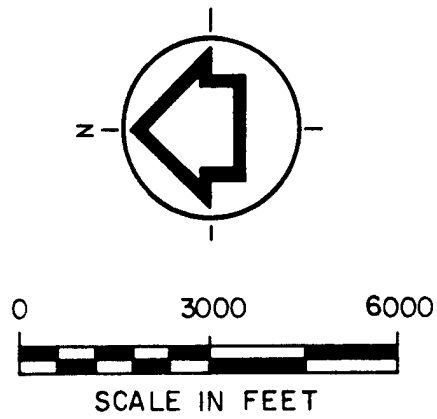
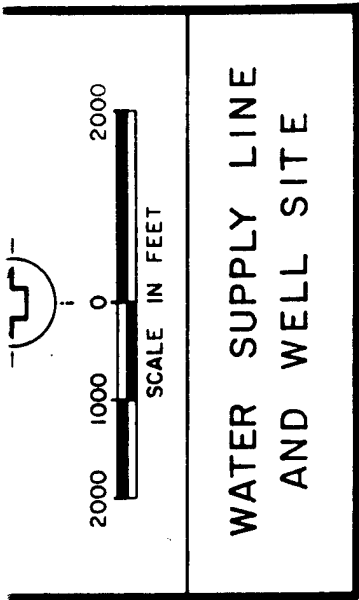




MASTER ENVIRONMENTAL PLAN JEFFERSON PROVING GROUND MADISON, INDIANA

EBAS





| | |
|----------|--|
| N UND | EBASCO ENVIRONMENTALS |
| | FIGURE 2.3 Facility Map |

areas, mostly due to removal of vegetation and soil disturbance from explosive impact.

2.4.2 Ground Water

While ground water monitoring wells have been installed at several locations, very little is known about the flow direction and quality of ground water at Jefferson Proving Ground. It is expected that regional ground water flow is generally from northeast to southwest, but variations in topography and geology influence local ground water flow.

Monitoring wells have been installed around the Gate 19 Landfill, the DU impact area and Building 279. Ground water flow direction at the Gate 19 Landfill is east to west or southeast to northwest, depending on season. Flow direction at Building 279 appears to be generally north to south, while flow direction at the DU impact area has not been reported.

In regarding ground water as a possible migration pathway, it is important to consider that while the limestones and shales in the area are relatively impermeable, secondary porosity, such as joints, fractures, and solution cavities, may allow rapid migration of ground water.

2.4.3 Facility Water Supply

Two wells from a well field supplied drinking water for the facility. The distribution lines from the wells to the consuming points on the facility required frequent maintenance and repair. The maintenance costs escalated to the point that using these wells was not cost effective. Consequently, in 1984, the wells were taken out of service. JPG now receives all of its drinking water from the City of Madison. The details of JPG's pumpstation wells located in downtown Madison are presented in Appendix V.

3.0 REGULATORY CONSIDERATIONS

The regulatory basis for the remediation of army bases scheduled for closure under CERCLA is E.O.12580 Section 2(d), ((e)(1)). E.O.12580 authorizes remediation of federal facility sites. No inter-agency agreement is required. CERCLA 104 authority is delegated to the department or agency responsible for the facility. However, despite the delegation of CERCLA authority, the clean up remains subject to all other federal statutes, rules and regulations. The project team will be required to deal with the overlap between the various regulating agencies. Resolution of regulatory agency overlaps are discussed in 54 FR 10520 3/13/89.

In addition to the various federal regulatory agencies, Sections 120 and 211 of SARA provide a role for state and local agencies in the decision making process. SARA 120 establishes that state laws are applicable to Non-NPL Federal Facilities. SARA 211 requires that state and local officials review and comment upon remedial action choices prior to the initiation of any such response action. Therefore, it is necessary that coordination between the agency or department involved, and federal, state and local agencies be achieved, to eliminate conflicts among overlapping regulatory requirements.

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980 and its amendment, the Superfund Amendments

and Reauthorization Act (SARA) of 1986, form the statutory basis for applying both federal and state standards to remedial actions at federal facilities such as the Jefferson Proving Ground (JPG). These laws require that remedial actions at federal facilities satisfy Applicable or Relevant and Appropriate Requirements (ARARs), unless such requirements are waived. Specifically, SARA requires compliance with the following laws:

- o Toxic Substance Control Act (TSCA)
- o Resource Conservation and Recovery Act (RCRA)
- o Hazardous and Solid Waste Amendment (HSWA) to RCRA
- o Safe Drinking Water Act (SDWA)
- o Clean Water Act (CWA)
- o Clean Air Act (CAA)
- o Marine Protection Research and Sanctuaries Act (MPRSA)

For the remediation of surface or ground water for drinking purposes, the relevant and appropriate federal cleanup standards are the maximum contaminant levels (MCLs). In cases where MCLs are not available for specific chemical contaminants, the United States Environmental Protection Agency (USEPA) recommends using human health advisory levels.

The corrective action program outlined in Section 3004(u), 3004(v), and 3008(h) of RCRA places special emphasis on cleanup problems resulting from past waste management practices at RCRA facilities.

JPG is classified as a large quantity generator of hazardous wastes. Therefore, the general RCRA compliance requirements for facility closure are applicable and should be reviewed. Where necessary, any corrective action plan should also address the protection of human health and the environment beyond the facility boundary.

The following sections discuss specific regulations which are applicable and relevant to JPG.

3.1 AMBIENT AND DRINKING WATER QUALITY CRITERIA

Although the extent of contamination (if any) by specific chemicals at JPG is unknown, all ambient water quality criteria should be reviewed and considered in developing an appropriate Master Environmental Plan (MEP). This section discusses federal and state ambient water quality requirements for surface and ground water remediation at JPG.

3.1.1 Federal

Table 3.1 shows the criteria for federal ambient water quality. The MCLs listed in Table 3.1 are enforceable standards for developing remedial actions. The Maximum Contaminant Level Goals (MCLGs) are recommended for guidance levels rather than enforceable standards. The MCLGs are zero for carcinogens. For other

substances, the MCLGs are set at levels below which no adverse health effects are known or anticipated. These levels include an adequate margin of safety (EPA, 1986).

The clean water quality criteria are based on a 10^{-6} lifetime risk level for toxic effects and carcinogenicity. The criteria for other risk levels can be calculated as indicated in Table 3.1, footnote. Organoleptic criteria are based on odor and taste, and are not health-based criteria. The ten-day and chronic health advisory criteria are based on a ten-day and continuous exposure respectively.

The federal clean water criteria must be considered for evaluating the potential for contamination of any drinking water sources as a result of JPG operations.

3.1.2 State of Indiana

This section presents an overview of applicable regulations for the State of Indiana. Water quality regulations for the state are classified into three broad categories: (1) Drinking Water, (2) Surface Water, and (3) Ground Water. The Maximum Contaminant Levels for drinking water adapted by the State of Indiana are the same as those included in the federal drinking water regulations and, thus, will not be addressed further here.

3.1.2.1 Surface Water

The State of Indiana has minimum water quality standards for all surface water. These requirements are discussed in detail in 327 IAC 2-1-6 of the Indiana Administrative Code, and summarized in Table 3.2. In addition, Indiana also has surface water quality criteria for specific substances. These are presented in Table 3.3. Surface water standards should be considered when evaluating the potential for contamination of any surface water body at JPG.

3.1.2.2 Ground Water

The State of Indiana does not currently have published standards for ground water quality. These standards are being developed. In the absence of published standards, the state recommends using surface water quality standards for clean up objectives for ground water contamination.

3.2 HAZARDOUS WASTE

This section presents an overview of federal and state regulations, and discusses regulations which are applicable to JPG operations.

Table 3.1 Federal Ambient and Drinking Water Quality Regulations and Criteria ($\mu\text{g/L}$ except as noted otherwise)^a

| Chemical | Safe Drinking Water Act | | | Clean Water Act, Water Quality Criteria ^c | | | |
|----------------------------|---|-------------------------------|--------------------------------|--|-------------------------------------|---|--|
| | Maximum Contaminant Level ^b ($\mu\text{g/L}$) | Health Advisories | | Maximum Contaminant Level Goal ^d ($\mu\text{g/L}$) | Human Health | | |
| | | 10-Day ($\mu\text{g/L}$) | Chronic ($\mu\text{g/L}$) | | Toxic Effect ($\mu\text{g/L}$) | Carcinogen ^e (10^{-6} risk) ($\mu\text{g/L}$) | Organoleptic ^f ($\mu\text{g/L}$) |
| Acenaphthene | -- | -- | -- | -- | -- | -- | 20 |
| Acrolein | -- | -- | -- | -- | -- | -- | 540 |
| Acrylonitrile | -- | -- | -- | 0 | -- | 0.063 | -- |
| Aldrin | -- | -- | -- | 0 | -- | 0.0012 | -- |
| Antimony | -- | -- | -- | -- | 146 | -- | -- |
| Arsenic | 50 | -- | -- | 0 | -- | 0.0025 | -- |
| Asbestos | -- | -- | -- | 0 | -- | 30,000 fibers/L | -- |
| Barium | 1,000 | -- | -- | 1,500 ^g | -- | -- | -- |
| Benzene | 5 | 230 | 70 | 0 | -- | 0.67 | -- |
| Benzidine | -- | -- | -- | 0 | -- | 0.00015 | -- |
| Beryllium | -- | -- | -- | 0 | -- | 0.0039 | -- |
| Cadmium | 10 | -- | -- | 5 ^g | 10 | -- | -- |
| Carbon tetrachloride | 5 | -- | -- | 0 | -- | 0.42 | -- |
| Chlordane | -- | 62.5 | 7.5 | 0 | -- | 0.022 | -- |
| Chlorinated benzenes | -- | -- | -- | -- | -- | -- | -- |
| Hexachlorobenzene | -- | -- | -- | 0 | -- | 0.021 | -- |
| 1,2,4,5-Tetrachlorobenzene | -- | -- | -- | -- | 180 | -- | -- |
| Pentachlorobenzene | -- | -- | -- | -- | 570 | -- | -- |
| p-Dichlorobenzene | 750 | -- | -- | 750 | -- | -- | -- |
| Monochlorobenzene | -- | -- | -- | 60 ^g | 488 | -- | -- |
| Chlorinated ethanes | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dichloroethane | 5 | -- | -- | 0 | -- | 0.94 | -- |
| 1,1,1-Trichloroethane | 200 | -- | 1,000 | 200 | 19,000 | -- | -- |
| 1,1,2-Trichloroethane | -- | -- | -- | 0 | -- | 0.6 | -- |

Table 3.1 (Cont'd.)

| Chemical | Safe Drinking Water Act | | | Clean Water Act, Water Quality Criteria ^c | | | |
|--|--|-------------------------------|--------------------------------|--|--|---|---|
| | Maximum Con- taminant Level ^b ($\mu\text{g/L}$) | Health Advisories | | Maximum Con- taminant Level Goal ^d ($\mu\text{g/L}$) | Human Health | | |
| | | 10-Day ($\mu\text{g/L}$) | Chronic ($\mu\text{g/L}$) | | Toxic Effect ($\mu\text{g/L}$) | Carcinogen ^e (10^{-6} risk) ($\mu\text{g/L}$) | Organo- leptic ^f ($\mu\text{g/L}$) |
| 1,1,2,2-Tetrachloroethane | -- | -- | -- | 0 | -- | 0.17 | -- |
| Hexachloroethane | -- | -- | -- | 0 | -- | 2.4 | -- |
| Chlorinated phenols | | | | | | | |
| 3-Chlorophenol | -- | -- | -- | -- | -- | -- | 0.1 |
| 4-Chlorophenol | -- | -- | -- | -- | -- | -- | 0.1 |
| 2,3-Dichlorophenol | -- | -- | -- | -- | -- | -- | 0.04 |
| 2,5-Dichlorophenol | -- | -- | -- | -- | -- | -- | 0.5 |
| 2-Chlorophenol | -- | -- | -- | -- | -- | -- | 0.1 |
| 2,4-Dichlorophenol | -- | -- | -- | -- | 3.09 | -- | -- |
| 2,6-Dichlorophenol | -- | -- | -- | -- | -- | -- | 0.2 |
| 3,4-Dichlorophenol | -- | -- | -- | -- | -- | -- | 0.3 |
| 2,3,4,6-Tetrachlorophenol | -- | -- | -- | -- | -- | -- | 1 |
| 2,4,5-Trichlorophenol | -- | -- | -- | -- | 2,600 | -- | -- |
| 2,4,6-Trichlorophenol | -- | -- | -- | -- | -- | 1.8 | -- |
| 2-Methyl-4-chlorophenol | -- | -- | -- | 0 | -- | -- | 1,800 |
| 3-Methyl-4-chlorophenol | -- | -- | -- | -- | -- | -- | 3,000 |
| 3-Methyl-6-chlorophenol | -- | -- | -- | -- | -- | -- | 20 |
| 1,2-Dichloropropane | -- | -- | -- | 6 ^g | -- | -- | -- |
| Chlorophenoxys | | | | | | | |
| 2,4-Dichlorophenoxyacetic acid (2,4-D) | 100 | -- | -- | 70 ^g | -- | -- | -- |
| 2,4,5-Trichlorophenoxypropionic acid (2,4,5-T) | 10 | -- | -- | 52 ^g | -- | -- | -- |
| Chloroalkyl ethers | | | | | | | |

Table 3.1 (Cont'd.)

| Chemical | Safe Drinking Water Act | | | Maximum Contaminant Level Goal ^d (µg/L) | Clean Water Act, Water Quality Criteria ^c | | |
|------------------------------|---|-------------------|----------------|--|--|--|----------------------------------|
| | Maximum Contaminant Level ^b (µg/L) | Health Advisories | | | Toxic Effect (µg/L) | Carcinogen ^e (10 ⁻⁶ risk) (µg/L) | Organoleptic ^f (µg/L) |
| | | 10-Day (µg/L) | Chronic (µg/L) | | | | |
| bis(Chloromethyl) ether | -- | -- | -- | 0 | -- | 3.9x10 ⁻⁶ | -- |
| bis(2-Chloroethyl) ether | -- | -- | -- | 0 | -- | 0.030 | -- |
| bis(2-Chloroisopropyl) ether | -- | -- | -- | -- | 34.7 | -- | -- |
| Chloroform | 100 ^h | -- | -- | 0 | -- | 0.19 | -- |
| Chromium (VI) | 50 | -- | -- | 120 ^g | 50 | -- | -- |
| Chromium (III) | -- | -- | -- | -- | 179,000 | -- | -- |
| Copper | -- | -- | -- | 1,300 ^g | -- | -- | 1,000 |
| Cyanide | -- | -- | -- | 200 | -- | -- | -- |
| DDT | -- | -- | -- | 0 | -- | >0.0012 | -- |
| Dichlorobenzenes | -- | -- | -- | 470 | -- | -- | -- |
| Dichlorobenzidines | -- | -- | -- | 0 | -- | 0.0207 | -- |
| 1,1-Dichloroethylene | 7 | -- | 70 | 0 | -- | 0.033 | -- |
| 1,2-Dichloroethylene (cis) | -- | 400 | -- | 70 ^g | -- | -- | -- |
| 1,2-Dichloroethylene (trans) | -- | 270 | -- | 70 ^g | -- | -- | -- |
| Dichloromethane | i | 1,300 | 150 | i | i | i | -- |
| Dichloropropylenes | -- | -- | -- | -- | 87 | -- | -- |
| Dieldrin | -- | -- | -- | 0 | -- | 0.0011 | -- |
| 2,4-Diemethylphenol | -- | -- | -- | -- | -- | -- | 400 |
| 2,4-Dinitrotoluene | -- | -- | -- | 0 | -- | 0.16 ^j | -- |
| 2,6-Dinitrotoluene | -- | -- | -- | 0 | -- | j | -- |
| p-Dioxane | -- | 568 | -- | -- | -- | -- | -- |
| 1,2-Diphenylhydrazine | -- | -- | -- | 0 | -- | 0.046 | -- |
| Endosulfan | -- | -- | -- | -- | 138 | -- | -- |
| Endrin | 0.2 | -- | -- | -- | 1 | -- | -- |

Table 3.1 (Cont'd.)

| Chemical | Safe Drinking Water Act | | | Maximum Contaminant Level Goal ^d (µg/L) | Clean Water Act, Water Quality Criteria ^c | | |
|-----------------------------------|---|-------------------|----------------|--|--|--|----------------------------------|
| | Maximum Contaminant Level ^b (µg/L) | Health Advisories | | | Human Health | | |
| | | 10-Day (µg/L) | Chronic (µg/L) | | Toxic Effect (µg/L) | Carcinogen ^e (10 ⁻⁶ risk) (µg/L) | Organoleptic ^f (µg/L) |
| Ethylbenzene | -- | -- | -- | 680 | 2,400 | -- | -- |
| Ethylene glycol | -- | -- | 5,500 | -- | -- | -- | -- |
| Formaldehyde | -- | 30 | -- | -- | 30 | -- | -- |
| Fluoranthene | -- | -- | -- | 188 | -- | -- | -- |
| Fluoride | 4,000 | -- | -- | 4,000 | -- | -- | -- |
| Halomethanes | -- | -- | -- | 0 | -- | 0.19 | -- |
| Heptachlor | -- | -- | -- | 0 | -- | 0.011 | -- |
| Hexachlorobutadiene | -- | -- | -- | 0 | -- | 0.45 | -- |
| Hexachlorocyclohexanes | -- | -- | -- | 0 | -- | 0.013 | -- |
| α-Hexachlorocyclohexane | -- | -- | -- | 0 | -- | 0.0232 | -- |
| β-Hexachlorocyclohexane | -- | -- | -- | 0 | -- | 0.0264 | -- |
| γ-Hexachlorocyclohexane (lindane) | 4 | -- | -- | 0 | -- | -- | -- |
| Hexachlorocyclopentadiene | -- | -- | -- | -- | 206 | -- | -- |
| n-Hexane | -- | 4,000 | -- | -- | -- | -- | -- |
| Isophorone | -- | -- | -- | -- | 5,200 | -- | -- |
| Kerosene/fuel oil No. 2 | -- | 350 ¹ | -- | -- | -- | -- | -- |
| Lead | 50 | -- | -- | 20 ^g | 50 | -- | -- |
| Mercury | 2 | -- | -- | 3 ^g | 10 | -- | -- |
| Methoxychlor | 100 | -- | -- | 340 ^g | -- | -- | -- |
| Methyl ethyl ketone | -- | 7,500 | 750 | -- | -- | -- | -- |
| Nickel | -- | -- | -- | -- | 15.4 | -- | -- |
| Nitrate, as N | 10,000 | -- | -- | 10,000 ^g | -- | -- | -- |
| Nitrobenzene | -- | -- | -- | -- | 19,800 | -- | -- |

Table 3.1 (Cont'd.)

| Chemical | Safe Drinking Water Act | | | Maximum Contaminant Level Goal ^d (µg/L) | Clean Water Act, Water Quality Criteria ^c | | | |
|-----------------------------------|---|-------------------|----------------|--|--|--|----------------------------------|----|
| | Maximum Contaminant Level ^b (µg/L) | Health Advisories | | | Human Health | | Organoleptic ^f (µg/L) | |
| | | 10-Day (µg/L) | Chronic (µg/L) | | Toxic Effect (µg/L) | Carcinogen ^e (10 ⁻⁶ risk) (µg/L) | | |
| Nitrophenols | | | | | | | | |
| 2,4-Dinitro-o-cresol | -- | -- | -- | -- | 13.6 | -- | -- | -- |
| Dinitrophenol | -- | -- | -- | -- | 70 | -- | -- | -- |
| Nitrosamines | | | | | | | | |
| N-Nitrosodimethylamine | -- | -- | -- | 0 | -- | 0.0014 | -- | -- |
| N-Nitrosodimethylamine | -- | -- | -- | 0 | -- | 0.0008 | -- | -- |
| N-Nitrosodi-n-butylamine | -- | -- | -- | 0 | -- | 0.0064 | -- | -- |
| N-Nitrosodiphenylamine | -- | -- | -- | 0 | -- | 7.0 | -- | -- |
| N-Nitrosopyrrolidine | -- | -- | -- | 0 | -- | 0.016 | -- | -- |
| Pentachlorophenol | -- | -- | -- | 220 ^g | 1,010 | -- | -- | -- |
| Phenol | -- | -- | -- | -- | 3,500 | -- | -- | -- |
| Phthalate esters | | | | | | | | |
| Dimethyl phthalate | -- | -- | -- | -- | 350,000 | -- | -- | -- |
| Diethyl phthalate | -- | -- | -- | -- | 434,000 | -- | -- | -- |
| Dibutyl phthalate | -- | -- | -- | -- | 44,000 | -- | -- | -- |
| Di-2-ethylhexyl phthalate | -- | -- | -- | -- | 21,000 | -- | -- | -- |
| Polychlorinated biphenyls (PCBs) | -- | 12.5 | -- | 0 | -- | >0.0126 | -- | -- |
| Polynuclear aromatic hydrocarbons | | | | | | | | |
| RDX | -- | -- | -- | 0 | -- | 0.0031 | -- | -- |
| Selenium | 10 | -- | -- | 45 ^g | 33.7 ^m | -- | -- | -- |
| Silver | 50 | -- | -- | -- | 10 | -- | -- | -- |
| 2,3,7,8-TCDD (dioxin) | -- | -- | -- | 0 | 50 | -- | -- | -- |
| | | | | | -- | 1.8x10 ⁻⁷ | -- | -- |

Table 3.1 (Cont'd.)

| Chemical | Safe Drinking Water Act | | | Clean Water Act, Water Quality Criteria ^c | | | |
|-----------------------|--|-------------------|-------------------|--|---------------------------|--|--|
| | Maximum Con- ta- nant Level ^b (µg/L) | Health Advisories | | Maximum Con- ta- nant Level Goal ^d (µg/L) | Human Health | | Organo- leptic ^f (µg/L) |
| | | 10-Day (µg/L) | Chronic (µg/L) | | Toxic Effect (µg/L) | Carcinogen ^e (10 ⁻⁶ risk) (µg/L) | |
| Tetrachloroethylene | -- | 175 | 20 | 0 | -- | 0.88 | -- |
| Thallium | -- | -- | -- | -- | 17.8 | -- | -- |
| Toluene | -- | 2,200 | 340 | 2,000 ^g | 15,000 | -- | -- |
| Toxaphene | 5 | -- | -- | 0 | -- | 25,800 | -- |
| Trichloroethylene | 5 | 200 | 75 | 0 | -- | 2.8 | -- |
| Trihalomethanes | 100 ^h | -- | -- | -- | -- | -- | -- |
| Trinitroglycerine | -- | -- | -- | -- | -- | 1.4 ⁿ | -- |
| Trinitrotoluene (TNT) | -- | -- | -- | -- | 44 ^m | -- | -- |
| Vinyl chloride | 2 | -- | -- | 0 | -- | 2 | -- |
| Xylenes | -- | 1,200 | 620 | 440 | -- | -- | -- |
| Zinc | -- | -- | -- | -- | -- | -- | 5,000 |

Table 3.1 Federal Ambient Water Quality Regulations and Criteria ($\mu\text{g/L}$ except as noted otherwise)^a

^aSource: EPA 1988, unless otherwise noted. A hyphen denotes the absence of a regulation or criterion.

^bThese standards are part of the national primary drinking water regulations (40 CFR 141).

^cThese criteria are recommended but not legally enforceable.

^dMCLGs are nonenforceable health goals that are set at a level at which no known or anticipated adverse health effect occurs and that allows an adequate safety margin. The MCLG for all carcinogens is zero.

^eTo obtain criteria for risks at 10^{-4} , 10^{-5} , and 10^{-7} , multiply the criteria by factors of 100, 10, and 0.1, respectively. Values are for ingestion of water only and do not include ingestion of fish.

^fOrganoleptic criteria are based on odor and taste; health-based water quality criteria are not available.

^gProposed MCLG value (see EPA 1989).

^hThe summed concentration of the four trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) must be less than 100 $\mu\text{g/L}$.

ⁱSee halomethane criteria.

^jSource: Etnier 1987. Insufficient data are available to estimate a human health water quality criterion for 2,6-dinitrotoluene. However, the existing data show that this isomer is a more potent carcinogen than the 2,4 isomer.

^kSee EPA 1989.

^lSeven-day health advisory for benzene and benzo(a)pyrene in kerosene, respectively.

^mSource: Erickson 1980.

ⁿSource: Smith 1986.

Table 3.2 General Surface Water Quality Criteria for the State of Indiana

| Parameter | Criteria |
|------------------------|--|
| <u>All Waters</u> | |
| Aesthetics | <p>All waters should be free of floating debris, oil, or scum.</p> <ul style="list-style-type: none"> (a) Settle to form objectionable deposits; (b) Contain substances in amounts sufficient to be unsightly or deleterious; (c) Produce color, odor, or other conditions in such degree as to create a nuisance; (d) Contain substances or materials in amounts sufficient to injure, be acutely toxic to, or otherwise produce serious adverse physiological responses in humans, animals, aquatic life, or plants. (e) Contain substances that could cause or contribute to the dominance of nuisance species of aquatic plants or algae. |
| Radioactive Substances | <p>The contamination of radium-226 and strontium-90 shall not exceed 3 and 10 picocuries per liter, respectively. In the absence of strontium-90 and alpha emitters, the gross beta concentrations shall not exceed 1,000 picocuries per liter.</p> |
| Tainting Substance | <p>There shall be no substances which impact unpalatable flavor to edible fish or result in noticeable offensive odors.</p> |

Table 3.2 (Cont'd.)

| Parameter | Criteria |
|-------------------|---|
| Dissolved Oxygen | Concentration of dissolved oxygen shall average at least 5.0 mg/l per calendar day and shall not be less than 4 mg/l at any time. In waters designated for trout fishing, dissolved oxygen concentration shall not be less than 6 mg/l. |
| Temperature | No heat shall be added where the natural reproduction of trout and salmon is to be protected. In other areas, temperatures shall not exceed 65 °F (18.3 °C) or 5 °F (2.8 °C) above natural, whichever is less. |
| pH | pH shall range between 6.0 and 9.0, except for daily fluctuations which exceed pH 9.0 and are correlated with photosynthetic activity. |
| Coliform Bacteria | <p>For waters designated for whole body contact recreation, fecal coliform bacteria shall not exceed 200 per 100 ml as a geometric mean based on a minimum of five samples per 4-week period.</p> <p>For waters designated for partial body contact recreation, fecal coliform bacteria shall not exceed 1,000 per 100 ml as a geometric mean based on a minimum of five samples per 4-week period.</p> |
| Dissolved Solids | The concentrations of certain chlorides or sulfates shall not exceed 250 mg/l other than due to naturally occurring sources. |

Source: Minimum Water Quality Standards
Indiana Administrative Code, 327 IAC 2-1-6,
September 1987.

Table 3.3: Specific Surface Water Quality Criteria for the State of Indiana

| Substances | AAC ¹ (Maximum) | CCC ² (4-Day Average) | | |
|--|---------------------------------------|--|-----------------|--------------------------|
| | | Outside of Mixing Zone | | Point of Water Intake |
| | | Aquatic Life (CAC) | Human Health | Human Health |
| <u>Metals (μg/l)</u> (Acid soluble, except as indicated) | | | | |
| Antimony | | | 45,000 (T) | 146 (T) |
| Arsenic (III)@ | 360 | 190 | 0.175 (C) | 0.022 (C) |
| Barium | | | | 1,000 (D) |
| Beryllium | | | 1.17 (C) | 0.068 (C) |
| Cadmium #@ | e ^(1.128[1n Hard*]-3.828) | e ^(0.7852[1n Hard]-3.490) | | 10 (D) |
| Chromium (III)#@ | e ^(0.8190[1n Hard]+3.688) | e ^(0.8190[1n Hard]+1.561) | 3,433,000 (T) | 170,000 (T) |
| Chromium (VI)@ | (dissolved) 16 | 11 | | 50 (D) |
| Copper # | e ^(0.9422[1n Hard]-1.464) | e ^(0.8545[1n Hard]-1.465) | | |
| Lead # | e ^(1.273[1n Hard]-1.460) | e ^(1.273[1n Hard]-1705) | | 50 (D) |
| Mercury @ | 2.4 | 0.012 | 0.15 (T) | 0.14 (T) |
| Nickel # | e ^(0.8460[1n Hard]+3.3612) | e ^(0.8460[1n Hard]+1.1645) | 100 (T) | 13.4 (T) |
| Selenium | 130** | 35 | | 10 (D) |
| Silver # | e ^{(1.72[1n Hard]-6.52)/2**} | | | 50 (D) |
| Thallium | | | 48 (T) | 13 (T) |
| Zinc # | e ^(0.8473[1n Hard]+0.8604) | e ^(0.8473[1n Hard]+0.76143) | | |
| <u>Organics (μg/l)</u> | | | | |
| Acrolein | | | 780 (T) | 320 (T) |
| Acrylonitrile | | | 6.5 (C) | 0.58 (C) |
| Aldrin @ | 1.5** | | 0.00079 (C) | 0.00074 (C) |
| Benzene @ | | | 400 (C) | 6.6 (C) |
| Benzidine | | | 0.0053 (C) | 0.0012 (C) |
| Carbon Tetrachloride | | | 69.4 (C) | 4.0 (C) |
| Chlordane @ | 1.2** | 0.0043 | 0.0048 (C) | 0.0046 (C) |
| Chlorinated Benzenes | | | | |
| Monochlorobenzene @ | | | | 488 (T) |
| 1,2,4,5-Tetrachlorobenzene | | | 48 (T) | 38 (T) |
| Pentachlorobenzene | | | 85 (T) | 74 (T) |
| Hexachlorobenzene @ | | | 0.0074 (C) | 0.0072 (C) |
| Chlorinated Ethanes | | | | |
| 1,2-dichloroethane | | | 2,430 (C) | 9.4 (C) |
| 1,1,1-trichloroethane @ | | | 1,030,000 (T) | 18,400 (T) |
| 1,1,2-trichloroethane @ | | | 418 (C) | 6.0 (C) |
| 1,1,2,2-tetrachloroethane @ | | | 107 (C) | 1.7 (C) |
| Hexachloroethane @ | | | 87.4 (C) | 19 (C) |
| Chlorinated Phenols | | | | |
| 2,4,5-trichlorophenol | | | | 2,600 (T) |
| 2,4,6-trichlorophenol @ | | | 36 (C) | 12 (C) |

Table 3.3: (Cont'd.)

| Substances | AAC ¹ (Maximum) | CCC ² (4-Day Average) | | |
|------------------------------|--------------------------------|-------------------------------------|-----------------|--------------------------|
| | | Outside of Mixing Zone | | Point of Water Intake |
| | | Aquatic Life (CAC) | Human Health | Human Health |
| Chloroalkyl Ethers | | | | |
| bis(2-chloroisopropyl) ether | | | 4,360 (T) | 34.7 (T) |
| bis(chloromethyl) ether | | | 0.018 (C) | 0.000038 (C) |
| bis(2-chloroethyl) ether | | | 13.6 (C) | 0.3 (C) |
| Chloroform | | | 157 (C) | 1.9 (C) |
| Chlorpyrifos | 0.083 | 0.041 | | |
| DDT @ | 0.55** | 0.0010 | 0.00024 (C) | 0.00024 (C) |
| Dichlorobenzenes @ | | | 2,600 (T) | 400 (T) |
| Dichlorobenzidine @ | | | 0.2 (C) | 0.1 (C) |
| 1,1-dichloroethylene | | | 18.5 (C) | 0.33 (C) |
| 2,4-dichlorophenol @ | | | | 3,090 (T) |
| Dichloropropenes | | | 14,100 (T) | 87 (T) |
| Dieldrin @ | 1.3** | 0.0019 | 0.00076 (C) | 0.00071 (C) |
| 2,4-dinitrotoluene @ | | | 91 (C) | 1.1 (C) |
| Dioxin (2,3,7,8-TCDD) @ | | | 0.0000001 (C) | 0.0000001 (C) |
| 1,2-diphenylhydrazine @ | | | 5.6 (C) | 0.422 (C) |
| Endosulfan @ | 0.11** | 0.056 | 159 (T) | 74 (T) |
| Endrin @ | 0.09** | 0.0023 | | 1.0 (D) |
| Ethylbenzene @ | | | 3,280 (T) | 1,400 (T) |
| Fluoranthene @ | | | 54 (T) | 42 (T) |
| Halomethanes | | | 157 (C) | 1.9 (C) |
| Heptachlor @ | 0.36** | 0.0038 | 0.0028 (C) | 0.0028 (C) |
| Hexachlorobutadiene @ | | | 500 (C) | 4.47 (C) |
| Hexachlorocyclohexane (HCH) | | | | |
| alpha HCH @ | | | 0.31 (C) | 0.09 (C) |
| beta HCH @ | | | 0.55 (C) | 0.16 (C) |
| gamma HCH (Lindane) @ | 1.00** | 0.080 | 0.63 (C) | 0.19 (C) |
| Technical HCH @ | | | 0.41 (C) | 0.12 (C) |
| Hexachlorocyclopentadiene @ | | | | 206 (T) |
| Isophorone | | | 520,000 (T) | 5,200 (T) |
| Nitrobenzene | | | | 19,800 (T) |
| Nitrophenols | | | | |
| 2,4-dinitro-o-cresol | | | 765 (T) | 13.4 (T) |
| Dinitrophenol | | | 14,300 (T) | 70 (T) |
| Nitrosamines | | | | |
| N-nitrosodiethylamine | | | 12.4 (C) | 0.008 (C) |
| N-nitrosodimethylamine | | | 160 (C) | 0.014 (C) |
| N-nitrosodibutylamine | | | 5.9 (C) | 0.064 (C) |
| N-nitrosodiphenylamine @ | | | 161 (C) | 49 (C) |
| N-nitrosopyrrolidine | | | 919 (C) | 0.16 (C) |
| Parathion @ | 0.065 | 0.013 | | |
| Pentachlorophenol @ | e ^(1.005[pH]-4.830) | e ^(1.005[pH]-5.290) | | 1,000 (T) |
| Phenol | | | | 3,500 (T) |

Table 3.3: (Cont'd.)

| <u>Substances</u> | <u>AAC¹</u> <u>(Maximum)</u> | <u>CCC²</u> <u>(4-Day Average)</u> | | |
|---|--|--|---------------|---------------------|
| | | <u>Outside of</u> | | <u>Point of</u> |
| | | <u>Aquatic</u> | <u>Human</u> | <u>Water Intake</u> |
| | | <u>Life (CAC)</u> | <u>Health</u> | <u>Human</u> |
| | | | | <u>Health</u> |
| Phthalate Esters | | | | |
| Dimethyl phthalate | | | 2,900,000 (T) | 313,000 (T) |
| Diethyl phthalate | | | 1,800,000 (T) | 350,000 (T) |
| Dibutyl phthalate @ | | | 154,000 (T) | 34,000 (T) |
| Di-2-ethylhexyl phthalate | | | 50,000 (T) | 15,000 (T) |
| Polychlorinated Biphenyls (PCBs) @ | | 0.014 | 0.00079 (C) | 0.00079 (C) |
| Carcinogenic Polynuclear Aromatic | | | | |
| Hydrocarbons (PAHs) @ | | | 0.31 (C) | 0.028 (C) |
| Tetrachloroethylene @ | | | 88.5 (C) | 8 (C) |
| Toluene @ | | | 424,000 (T) | 14,300 (T) |
| Toxaphene @ | 0.73 | 0.0002 | 0.0073 (C) | 0.0071 (C) |
| Trichloroethylene @ | | | 807 (C) | 27 (C) |
| Vinyl Chloride | | | 5,246 (C) | 20 (C) |
| <u>Other Substances</u> | | | | |
| Asbestos (fibers/liter) | | | | 300,000 (C) |
| Chlorides (mg/l) | 860 | 230 | | |
| Chlorine | | | | |
| (Total Residual) (µg/l) | 19 | 11 | | |
| Chlorine ^a (mg/l) (intermittent, | | | | |
| total residual) | 0.2 | | | |
| Cyanide (Total) (µg/l) | 22 | 5.2 | | 200 (D) |
| Nitrate-N + Nitrate-N (mg/l) | | | | 10 (D) |
| Nitrite-N (mg/l) | | | | 1.0 (D) |

Dissolved solids shall not exceed 750 mg/l in all waters.

Fluoride shall not exceed 2.0 mg/l in all waters, except the Ohio River and Interstate Wabash River where it shall not exceed 1.0 mg/l.

Sulfates shall not exceed 250 mg/l in all waters.

* Natural logarithm of hardness in milligrams per liter CaCO₃.

** One-half (1/2) of the final acute value (FAV) as calculated by procedures developed by U.S.EPA in 1980. This value would correspond to acute aquatic values calculated using IDEM procedures or U.S.EPA procedures developed in 1985 in which the calculated FAV is divided by two (2) to reduce acute toxicity.

Table 3.3 (Cont'd.)

T is derived from threshold toxicity.

C is derived from nonthreshold cancer risk.

D is derived from drinking water standards, equal to or less than threshold toxicity.

@ This substance, which has a log octanol-water partition coefficient greater than or equal to two (2.0), is considered to be bioconcentrating and of concern.

* To be considered an intermittent discharge, total residual chlorine shall not be detected in the discharge for a period of more than forty (40) minutes in duration and such periods shall be separated by at least five (5) hours.

1 Acute Aquatic Criteria (AAC)

2 Continuous Criterion Concentrations

3.2.1 Federal

Solid wastes are divided into two categories -- hazardous and nonhazardous. For regulatory purposes, solid wastes are hazardous if they are among any of the following: (1) those listed in 40 CFR 261, Subpart D; (2) those having at least one of four characteristics listed in 40 CFR 261, Subpart C; or (3) those that contain a hazardous constituent listed in 40 CFR 261, Appendix VIII. A waste may be excluded from regulation by 40 CFR 261, Appendix IV. If not specifically or categorically excluded, a waste may still be considered hazardous unless a determination is made that the waste "is not capable of posing a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed" (40 CFR 261.11).

Wastes can be characteristically hazardous (Subpart C) based on ignitability, corrosivity, reactivity, or exceedance of a prescribed concentration when extracted (EP toxicity). Extraction procedure toxicity tests the leachability of 14 chemical compounds regulated by the National Interim Primary Drinking Water Standards (40 CFR 141). In 1986, EPA proposed to amend the EP toxicity test by expanding the list of components and introducing a new leaching procedure known as the toxicity characteristic leaching procedure (TCLP). Table 3.4 lists the regulatory limits for these components.

Table 3.4 Regulatory Limits for Contaminants for the
Toxicity Characteristic Leaching Procedure (TCLP)

| Contaminant | mg/l | Contaminant | mg/l |
|-----------------------------------|-------|---------------------------|------|
| Acrylonitrile | 5.0 | Isobutanol | 36 |
| Arsenic | 5.0 | Lead | 5.0 |
| Barium | 100.0 | Lindane | 0.4 |
| Benzene | 0.5 | Mercury | 0.2 |
| Bis(2-chloroethyl) ether | 0.05 | Methoxychlor | 10 |
| Cadmium | 1.0 | Methylene chloride | 8.6 |
| Carbon disulfide | 14.4 | Methyl ethyl ketone | 200 |
| Carbon tetrachloride | 0.5 | Nitrobenzene | 2.0 |
| Chlordane | 0.03 | Pentachlorophenol | 100 |
| Chlorobenzene | 100 | Phenol | 14.4 |
| Chloroform | 6.0 | Pyridine | 5.0 |
| Chromium | 5.0 | Selenium | 1.0 |
| o-Cresol | 200 | Silver | 5.0 |
| m-Cresol | 200 | 1,1,1,2-Tetrachloroethane | 10.0 |
| p-Cresol | 200 | 1,1,2,2-Tetrachloroethane | 1.3 |
| 2,4-D | 10 | Tetrachloroethylene | 0.7 |
| 1,2-Dichlorobenzene | 4.3 | 2,3,4,6-Tetrachlorophenol | 1.5 |
| 1,4-Dichlorobenzene | 7.5 | Toluene | 14.4 |
| 1,2-Dichloroethylene | 0.40 | Toxaphene | 0.5 |
| 1,1-Dichloroethylene | 0.7 | 1,1,1-Trichloroethane | 30 |
| 2,4-Dinitrotoluene | 0.13 | 1,1,2-Trichloroethane | 1.2 |
| Endrin | 0.02 | Trichloroethylene | 0.07 |
| Heptachlor (and its hydroxide) | 0.008 | 2,4,5-Trichlorophenol | 400 |
| Hexachlorobenzene | 0.13 | 2,4,6-Trichlorophenol | 2.0 |
| Hexachlorobutadiene | 0.72 | 2,4,5-TP (Silvex) | 1.0 |
| Hexachloroethane | 3.0 | Vinyl chloride | 0.2 |

Source: 51 FR 21648.

A solid waste is reactive if it is capable of (1) detonation or explosive reaction when subject to a strong initiating source or heated under confinement or (2) detonation or explosive decomposition at standard temperature and pressure. Explosives are included under reactivity. Two classes of explosives are relevant for JPG -- Class A and Class B. Class A contains detonating explosives, including priming devices (such as lead azide) and high explosives (such as TNT, tetryl, and black powder). Class B contains rapidly burning explosives (such as propellants). Both classes of explosives have been used at JPG.

A solid waste exhibits the characteristic of ignitability if it meets any of the following criteria:

- o It is a nonaqueous liquid and has a flash point below 140 °F;
- o It is not a liquid and can cause fire through friction, absorption of moisture, or spontaneous chemical change;
- o When ignited, it burns so vigorously and persistently that it creates a hazard; or
- o It is an ignitable compressed gas or an oxidizer.

A solid waste is characteristically corrosive if (1) it has a pH less than or equal to 2 or a pH greater than or equal to 12.5 or (2) it is a liquid that corrodes steel (under prescribed conditions).

3.2.2 State of Indiana

The requirements for Hazardous Waste Management in the State of Indiana are codified in the Indiana Administrative Code 329 IAC, Article 3. This section of the code defines all the necessary regulatory terms, specifies how a waste may be classified as

hazardous by characteristics and presents a list of hazardous wastes. In general, these codes mirror federal requirements.

The exceptions to hazardous waste regulations applicable to generators of solid wastes are:

- o Domestic sewage;
- o Any mixture of domestic sewage and other wastes passing through a sewer system to a publicly owned treatment works;
- o Industrial wastewater discharges that are point source discharges subject to regulation under Section 402 of the Clean Water Act (33 U.S.C. 1342), as amended;
- o Irrigation return flows;
- o Source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011);
- o Household wastes;

- o Samples collected for the sole purpose of testing to determine their properties, characteristics, or composition (when complying with given requirements);

3.3 HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984

The Hazardous and Solid Waste Amendments of 1984 (HSWA) greatly expanded authorities under RCRA for requiring corrective action for releases of hazardous wastes and constituents at facilities that manage hazardous wastes. The HSWA banned the land disposal of hazardous wastes that did not meet treatment standards prior to disposal and require the EPA to review certain solvents and dioxins, California list wastes, and all remaining hazardous wastes at a rate of one-third of listed wastes by August 8, 1988; two-thirds by June 8, 1989; and all listed waste by May 8, 1990. All characteristic hazardous wastes were to be reviewed by May 8, 1990. These deadlines were imposed by Congress to severely restrict the disposal of hazardous waste into landfills, surface impoundments, injection wells, and other land disposal facilities. All of these deadlines have passed and treatment standards are in effect for almost all of the listed and characteristic hazardous wastes.

Tables 3.5 - 3.7 list the treatment standards for dioxin wastes, solvents and California list wastes.

**Table 3.5 Treatment Standards for
Dioxin Wastes (ppm)**

| Dioxin | Concen- tration |
|------------------------------|--------------------|
| Hexachlorodibenzo-p-dioxins | <0.001 |
| Hexachlorodibenzofurans | <0.001 |
| Pentachlorodibenzo-p-dioxins | <0.001 |
| Pentachlorodibenzofurans | <0.001 |
| Tetrachlorodibenzo-p-dioxins | <0.001 |
| Tetrachlorodibenzofurans | <0.001 |
| 2,4,5-Trichlorophenol | <0.05 |
| 2,4,6-Trichlorophenol | <0.05 |
| 2,3,4,6-Tetrachlorophenol | <0.10 |
| Pentachlorophenol | <0.01 |

Source: 51 FR 40572.

Table 3.6 Treatment Standards for Wastes Contaminated with F001-F005 Solvents (mg/L)

| F001-F005 Solvent Constituents | Wastewaters Containing Spent Solvents | All Other Spent Solvent Wastes |
|---------------------------------------|---|--------------------------------------|
| Acetone | 0.05 | 0.59 |
| n-Butyl alcohol | 5.0 | 5.0 |
| Carbon disulfide | 1.05 | 4.81 |
| Carbon tetrachloride | 0.05 | 0.96 |
| Chlorobenzene | 0.15 | 0.05 |
| Cresols (and cresylic acid) | 2.82 | 0.75 |
| Cyclohexanone | 0.125 | 0.75 |
| 1,2-Dichlorobenzene | 0.65 | 0.125 |
| Ethyl acetate | 0.05 | 0.75 |
| Ethyl benzene | 0.05 | 0.053 |
| Ethyl ether | 0.05 | 0.75 |
| Isobutanol | 5.0 | 5.0 |
| Methanol | 0.25 | 0.75 |
| Methylene chloride | 0.20 | 0.96 |
| Methylene chloride ^a | 12.7 | 0.96 |
| Methyl ethyl ketone | 0.05 | 0.75 |
| Methyl isobutyl ketone | 0.05 | 0.33 |
| Nitrobenzene | 0.66 | 0.125 |
| Pyridine | 1.12 | 0.33 |
| Tetrachloroethylene | 0.079 | 0.05 |
| Toluene | 1.12 | 0.33 |
| 1,1,1-Trichloroethane | 1.05 | 0.41 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.05 | 0.96 |
| Trichloroethylene | 0.062 | 0.091 |
| Trichlorofluoromethane | 0.05 | 0.96 |
| Xylene | 0.05 | 0.15 |

^aFrom the pharmaceutical industry.

Source: 51 FR 40572.

Table 3.7 Treatment Standards for California List Wastes

| California List Waste | Treatment Standard | Comment |
|--|--------------------|---|
| Free cyanides | 1,000 mg/L | The PFLT ^a is recommended for determining the liquidity; method 9010 is recommended for testing the liquid portion. |
| Metals (elements or compounds) | | |
| Arsenic | 500 mg/L | The PFLT is recommended for determining the liquidity; see Chapter 3 of SW-846 for recommended test methods. |
| Cadmium | 100 mg/L | |
| Chromium | 500 mg/L | |
| Lead | 500 mg/L | |
| Mercury | 20 mg/L | |
| Nickel | 134 mg/L | |
| Selenium | 100 mg/L | |
| Thallium | 130 mg/L | |
| Corrosives | ≤2.0 pH | The PFLT is required for determining the liquidity; see 40 CFR 261.22(A)(1) for the required test. |
| Polychlorinated biphenyls ^b | 50 ppm | Both liquid and solid portions of waste must be tested. |
| Halogenated organic compounds (HOCs) in dilute waste-water | 1,000 mg/L | Applies to liquid hazardous waste consisting primarily of water with an HOC content of less than 1% or 10,000 mg/L; both liquid and solid portions of waste must be tested. |
| Other HOCs | 1,000 mg/L | Applies to all other liquid and solid wastes containing HOCs; both liquid and solid portions of waste must be tested. |

^aPaint filter liquids test.

^bApplies to liquid wastes (as determined by the PFLT method) containing (1) any chemical substance limited to biphenyl molecule that has been chlorinated to varying degrees or (2) any combination of substances containing a substance listed in 40 CFR Part 266 or having any of the four hazardous characteristics listed in 40 CFR 261, Subpart C.

Source: 52 FR 25760.

Land disposal under the HSWA is defined as placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome or bed formation, underground mine or cave, or concrete vault or bunker. Restrictions apply to wastes to be disposed after the effective date of the prohibition. Wastes that are land disposed prior to the applicable effective date for prohibition do not have to be removed for treatment. However, any hazardous wastes that are removed after the effective date are subject to disposal restrictions and treatment provisions (40 CFR 268.2).

Pursuant to the HSWA, RCRA authorizes EPA to require corrective action under an order or as part of a permit whenever there is or has been a release of hazardous waste or constituents into the environment. The HSWA further directs EPA to require corrective action beyond the facility boundary on a case-by-case basis. Current operations at JPG are in full compliance with applicable state and federal hazardous waste regulations. However, past waste management practices could have resulted in a potential release. Applicable regulations should therefore be reviewed as part of a thorough evaluation of past operations.

3.4 SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) OF 1986

SARA, enacted on January 21, 1986, specifies cleanup standards, outlines provisions for federal facilities, and defines an environmental restoration program to be carried out at U.S. Department of Defense (DOD) facilities. The federal facilities provisions (Sec. 120) of SARA state that all federal facilities are subject to the same guidelines, rules, regulations, and criteria for hazardous substances that are applicable to any nonfederal facility. This applies in particular to preremedial activities, remedial actions, and evaluations under the National Contingency Plan. Remedial actions at DOD or U.S. Department of Energy (DOE) facilities may be modified as necessary to protect national security interests.

SARA provisions on cleanup standards (Sec. 121) state that remedial actions in which the volume, mobility, or toxicity of hazardous substances or contaminants is permanently and significantly reduced by treatment are preferred over passive actions, such as land disposal without treatment. Off-site transport and disposal without such treatment should be the least-preferred action if practicable treatment technologies are available. Any off-site transfer of hazardous substances must be to an approved facility. The unit receiving the hazardous substances must not be releasing any hazardous waste or constituent into the ground water, surface water, or soil. Appendix II presents a list of analytes considered

to be part of the Target Compound List (TCL). This list of analytes is typically used for analytical purposes when the source, and the constituents of the hazardous waste is unknown.

Remedial actions must be selected to attain a degree of cleanup that ensures protection of human health and the environment. Pollutants or hazardous substances remaining after completion of the remedial action are subject to all legally applicable or relevant and appropriate requirements (ARARs).

Section 121(d)(2) of CERCLA, as amended by SARA, also states that remedial actions should satisfy ARARs under the SDWA, CWA, SWDA and TSCA. Specifically, this section requires that MCLGs and federal water quality criteria (Table 3.1) should be satisfied where they are relevant and appropriate for an actual or potential release. This section also states that any ARARs under State environmental laws that are more stringent than Federal standards are to be satisfied by remedial actions.

Section 211 of SARA describes an environmental restoration program for DOD facilities such as JPG. The program is to be carried out in consultation with the EPA, and is subject to the requirements given in Sec. 120 (federal facilities) of CERCLA. The goals for the program include the following:

1. Identification, investigation, research and development, and cleanup of contamination from hazardous substances, pollutants, and contaminants.
2. Correction of other environmental damage (such as detection and disposal of unexploded ordnances) that may create an imminent and substantial threat to the public health or welfare or to the environment.
3. Demolition and removal of unsafe buildings and structures, including buildings and structures at sites formerly used by the DOD or under the jurisdiction of the Secretary of Defense.

4.0 SITE ASSESSMENTS AND PROPOSED PLANS

Several studies have been conducted at JPG to identify areas requiring environmental evaluations. The USATHAMA Installation Assessments (August 1980, and January, 1988), The Ground Water Contamination Survey - Evaluation of Solid Waste Management Units (August, 1988), and the Enhanced Preliminary Assessment Report (March, 1990) provide sufficient updated information to outline a plan of recommended actions to address environmental concerns and comply with applicable environmental regulations.

This section recommends a plan of action for the entire facility. The description is presented in terms of a plan of action for the following areas:

- o South of the Firing Line (West)
- o South of the Firing Line (East)
- o The Firing Line
- o North of the Firing Line
- o The Gate 19 Area
- o Other Areas of Environmental Concern

For each unit within a given area, this section presents a brief background highlighting the environmental concerns and recommends the appropriate actions necessary to address those concerns.

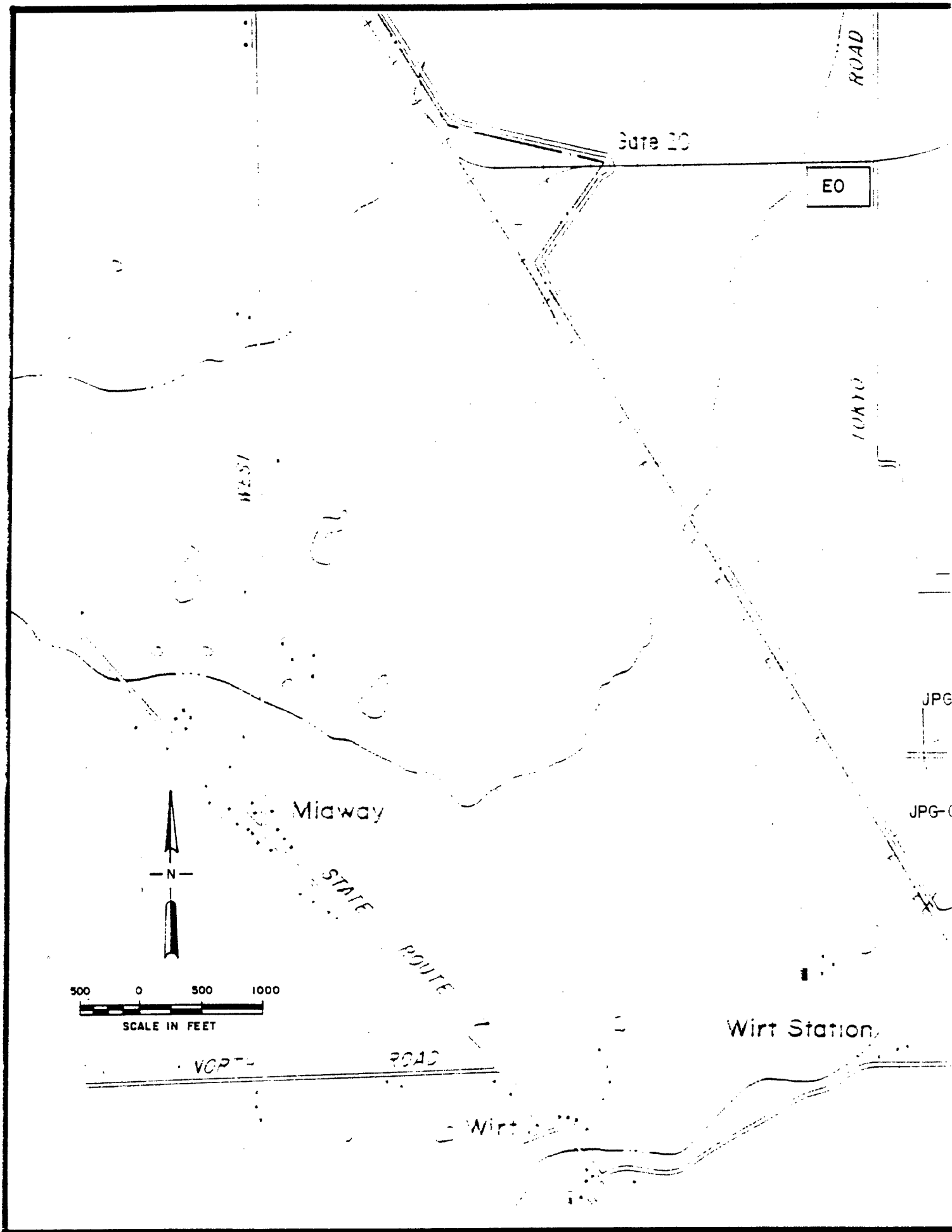
4.1 SOUTH OF THE FIRING LINE (WEST SIDE)

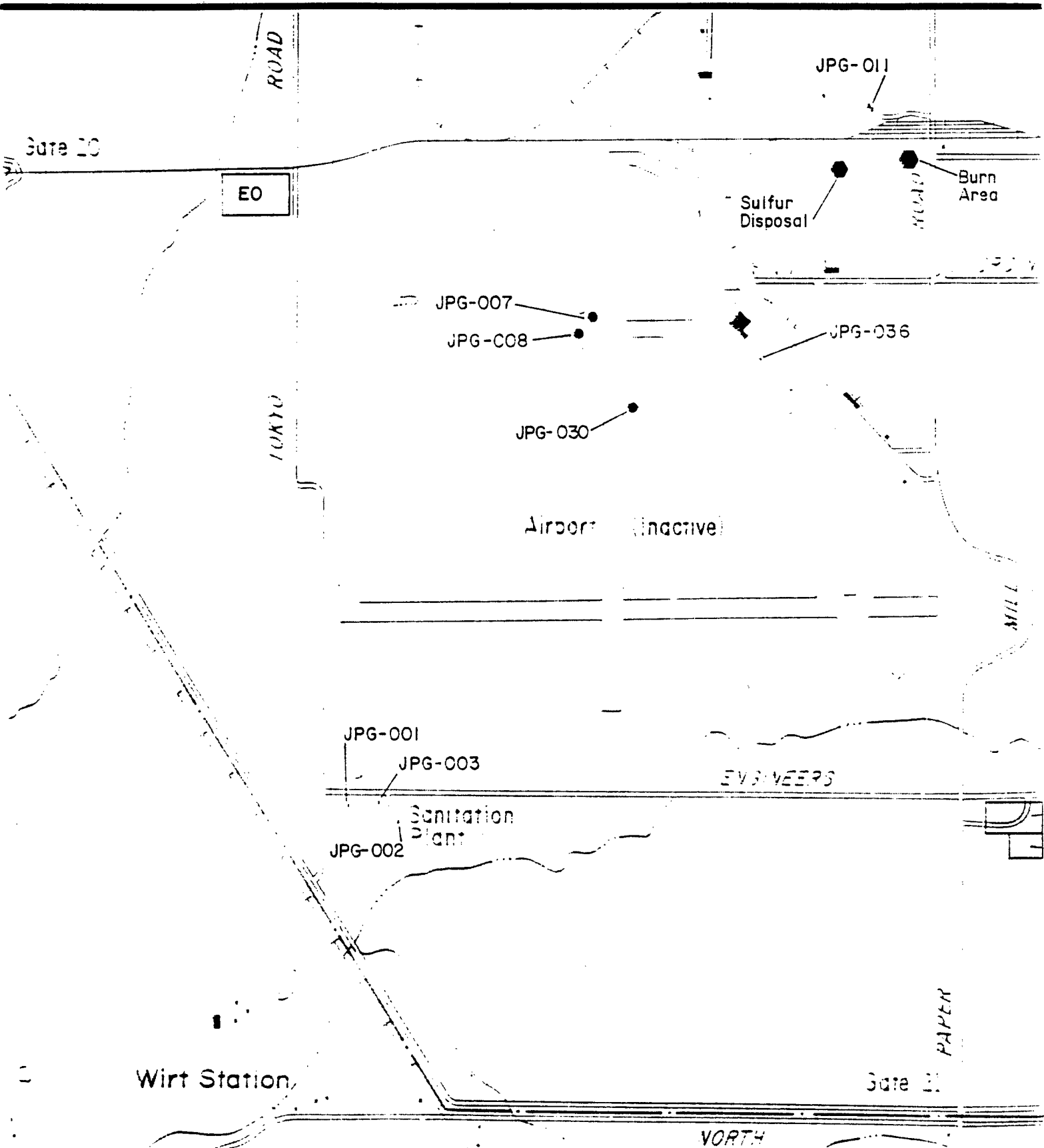
This area contains ten (10) designated solid waste management units. In addition, the Enhanced Preliminary Assessment Report identifies three (3) areas of environmental concern (Figure 4.1).

4.1.1 Building 185 (Old Incinerator) - JPG-001

JPG-001 is a Morse-Boulger, single chamber, single-burner, single stack incinerator without an afterburner unit (Figure 4.2). This incinerator is located in a 800 square foot-building and was used from approximately 1941 to 1978 to burn debris, small ammunition, and paper products from the installation.

The applicable contaminant release mechanism is air transportation of particulates vented to the atmosphere during operations. However, no environmental migration pathway or exposure potential currently exists because the unit is not active. No evidence of release was observed during site visits.

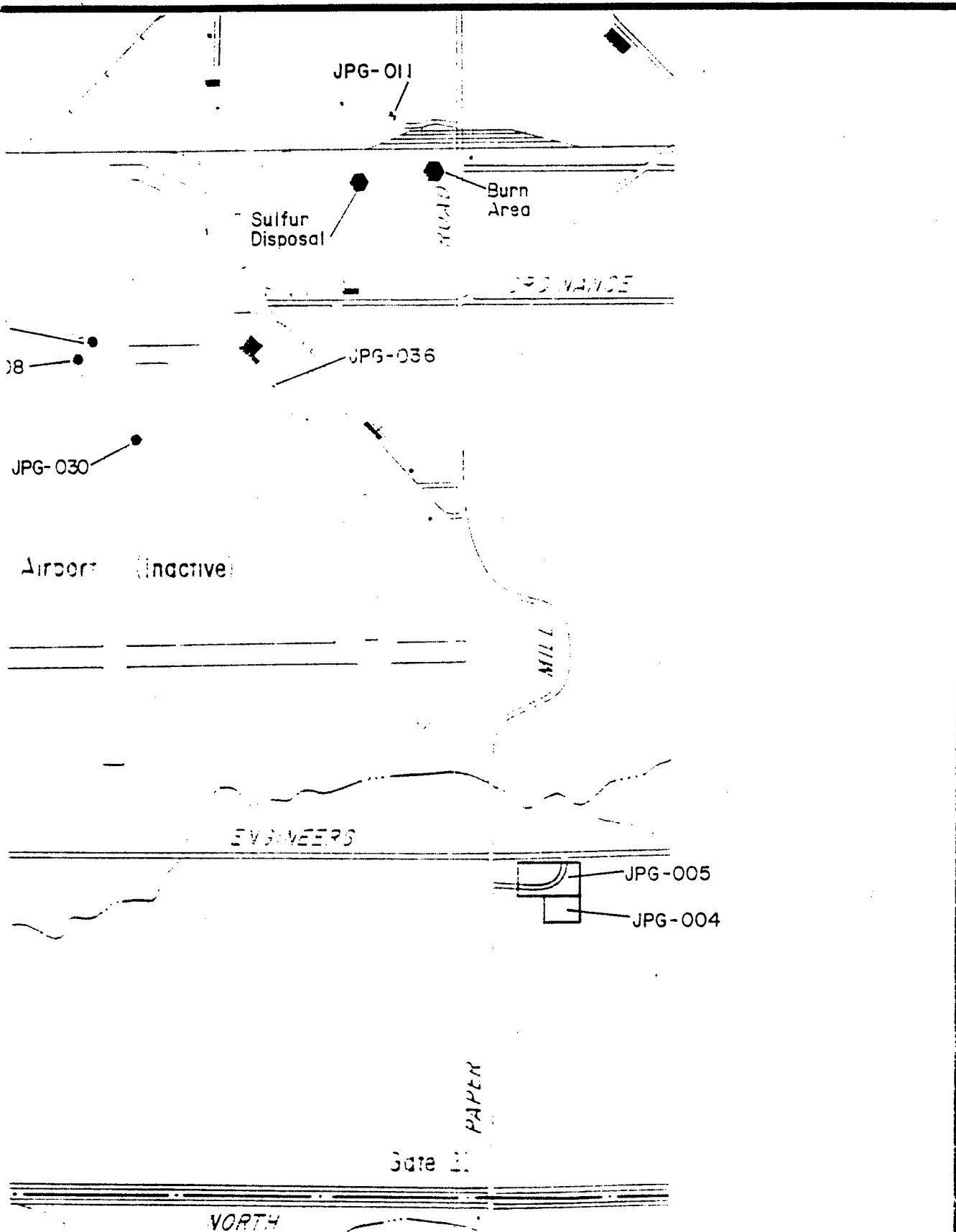




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JEFFERSON PROVING GROUND
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EBAS

JPG-001, 030, 036

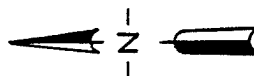
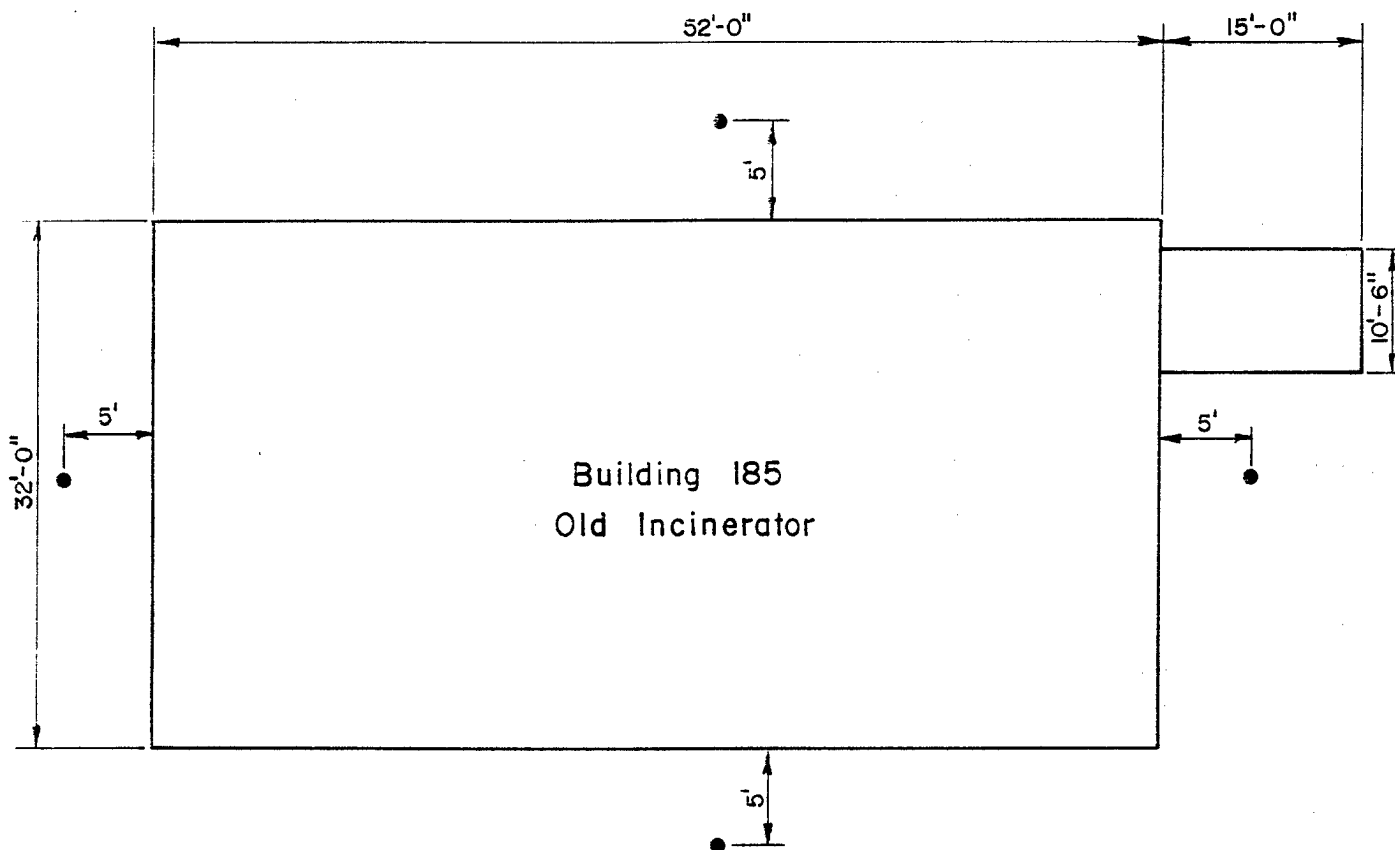


MASTER ENVIRONMENTAL PLAN
JEFFERSON PROVING GROUND
MADISON, INDIANA

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FIGURE 4.1

JPG-001,002,003,004,005,007,008,
011,030,036, EO Contamination, Sulfur Disposal,
and Burn Areas



Not to Scale

LEGEND

- Approximate Location for Proposed Soil Samples

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FIGURE 4.2

Building 185-Old Incinerator

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JEFFERSON PROVING GROUND
Madison, Indiana

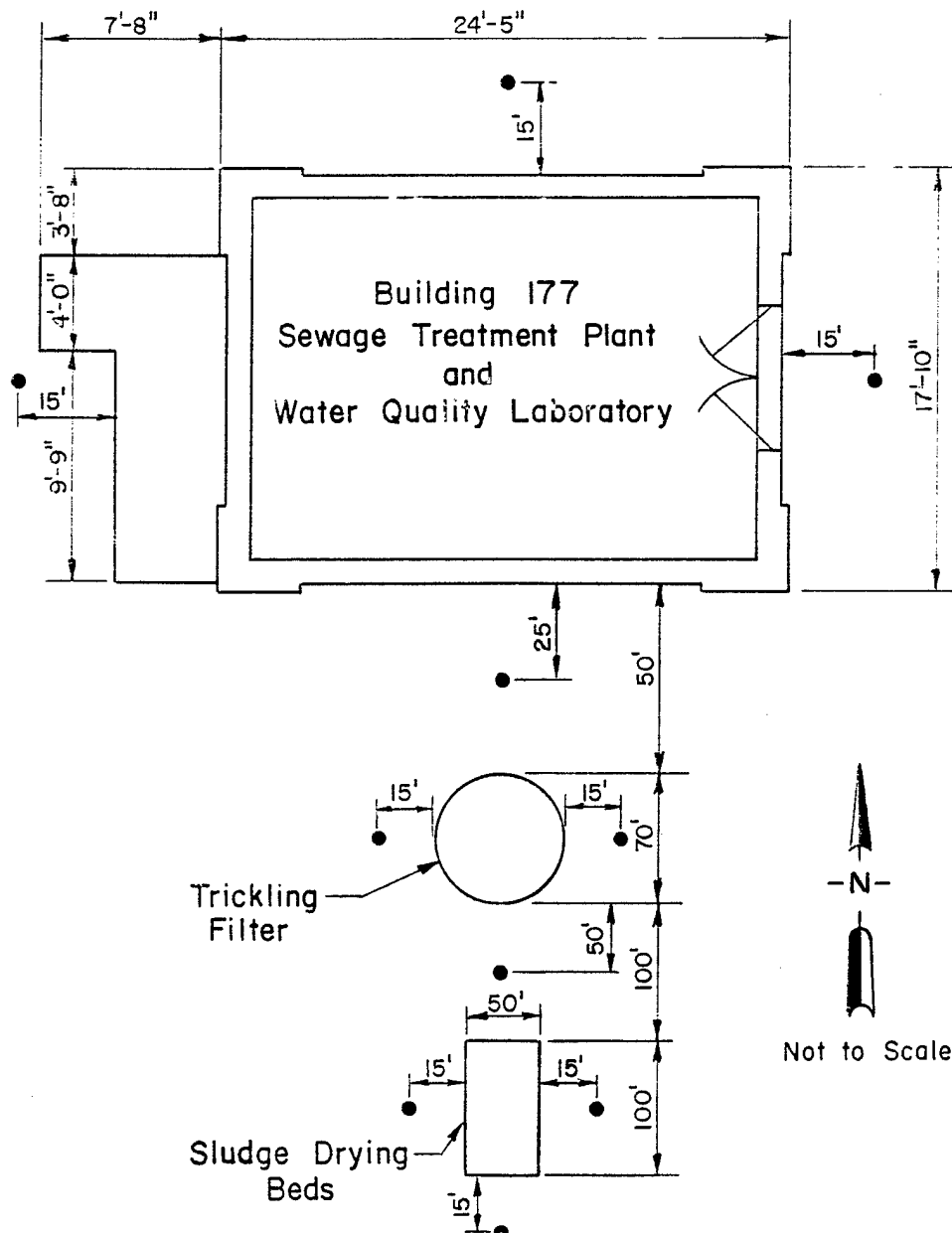
4.1.1.1 Proposed Action

As part of the closure procedure, one scrape sample should be collected from the top of the incinerator stack (outside) and one sample from inside the chamber and analyzed for TCLP metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se). The incinerator equipment may require decontamination or dismantling depending upon the analytical results. Approximately one soil sample should be collected from within 6 inches of the surface on each side of the incinerator building. These surface samples should be collected close to the building and analyzed for TCLP metals (Ag, As Ba, Cd, Cr, Pb, Hg and Se).

4.1.2 Water Quality Laboratory - JPG-002

JPG-002 is an 832 square foot water quality laboratory. The laboratory has been used for testing water quality at the sewage treatment plant since the 1960s (Figure 4.3). The laboratory is located on the first floor of Building 177. The pumping station of the sewage treatment plant (JPH-003) is also located in the same building.

The specific wastes generated at the water quality laboratory include a small quantity of spent chemicals generated from laboratory analyses. In the past, some of these chemicals appear to have been improperly disposed. However, the sewer system has been upgraded, and the standard operating procedures for the



LEGEND

- Approximate Location for Proposed Soil Samples

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FIGURE 4.3

Building 177-Sewage Treatment
Plant and Water Quality Laboratory

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JEFFERSON PROVING GROUND
Madison, Indiana

laboratory have substantially improved to facilitate proper use and disposal of chemicals at JPG.

4.1.2.1 Proposed Action Plan

No Recommended Action.

4.1.3 Building 177 (Sewage Treatment Plant) - JPG-003

The sewage treatment plant building covers an area of approximately 682 square feet with a capacity to process approximately 280,000 gallons per day of waste water (Figure 4.3). The water analysis laboratory described in section 4.1.2 is located on the first floor of this building. The pumping station is located in the basement. The plant was recently upgraded. The majority of the wastewater is sanitary (domestic sewage). A small quantity of industrial wastewater consisting of photographic wastes (170 gallons per day) is also treated at the plant.

4.1.3.1 Proposed Action Plan

Approximately ten (10) soil samples should be collected from around the building, trickling filter and sludge drying beds and analyzed for total concentration of silver, TCLP silver and cyanides. If the total concentration of silver is below the regulated limit (5 mg/L) in the TCLP extract, TCLP analyses will not be necessary.

4.1.4 Explosives Burning - JPG-004

JPG-004 is a 2-acre thermal treatment area formerly used for open burning of explosives and other burnables. The materials burned in this area included fuses, waste propellant, boxes, lumber and paint residues. Waste materials of concern in this area include selected constituents of explosives and heavy metals.

This area is no longer used for open burning. However, a recent interview with a former JPG employee revealed that red lead may have been dumped in this area also. The surface deposits in this area consist of sandy to silty soils with low organic and high clay content.

4.1.4.1 Proposed Action Plan

A geophysical survey using equipment such as ground penetrating radar, conductivity or resistivity meter or a magnetometer, should be conducted to determine the location and depth of the trenches used in burning operations.

Up to twenty (20) soil samples, taken at the ground surface and below the trench bottoms, should be collected from this area and analyzed for explosives residues such as TNT, DNT, RDX, HMX, HNS, nitrocellulose, nitroguanidine, tetryl and TCLP metals (Ag, As,

Cd, Cr, Pb and Hg). The locations and number of samples should be determined from field inspections. This sampling program should be coordinated with the sampling program for the adjacent landfill.

If soil samples are shown to be contaminated, ground water monitoring wells should be installed. Water from these wells should be analyzed for the same parameters as the soil samples. The installation and sampling of these wells should be coordinated with the well installation program for the adjacent landfill (see Section 4.1.5.1).

4.1.5 Landfill - JPG-005

This is a one-acre landfill comprised of filled-in trenches of unknown depth. The landfill was used from approximately 1941 to 1970 primarily as a dumping ground for film refuse from the photographic laboratory. In addition, spent solvents and red lead were also reportedly disposed in this area. Red lead (lead oxide) is one of the materials present in Component B of the filler used in inert projectiles. As much as 60% of Compound B was lead oxide until it was replaced by iron oxide after 1978. The lead dumped at this landfill came not only from buried projectiles, but also from unused bulk lead oxide. No records were maintained of materials disposed in this landfill, which is currently overgrown, abandoned, and barely discernable. The potential contaminant release mechanism is the migration of contaminants through soils

to the ground water in this area. No soil or water samples have been collected from this area to establish the nature and extent of any contamination.

4.1.5.1 Proposed Action

A geophysical investigation using equipment such as ground penetrating radar, resistivity or conductivity meter, should be conducted to delineate the landfill boundaries. Approximately 8 soil samples should be collected from four boreholes at depth intervals of 0-2 ft and 2-5 ft. The soils collected should be analyzed for Target Compound List (TCL) parameters. If possible, at least one sample from each hole should be taken at the soil/waste interface. A ground water monitoring program should be developed and implemented to determine whether or not the ground water in the area is contaminated with materials such as volatile organics, pesticides, and heavy metals. This program should include the installation of approximately four monitoring wells around the landfill (one up gradient and three down gradient). More monitoring wells may be needed depending on actual site conditions. If surface water is encountered during the RI, in the immediate vicinity of the site, then this water should be sampled and analyzed for TCL parameters.

4.1.6 Wood Storage Pile - JPG-007

This area consists of a 10 foot high waste pile covering approximately 300 square feet on an abandoned airport runway. The waste pile consists of wood debris, plywood struts, boxes, pallets and used crates.

4.1.6.1 Proposed Action

No recommended action.

4.1.7 Contaminated Wood Storage Pile - JPG-008

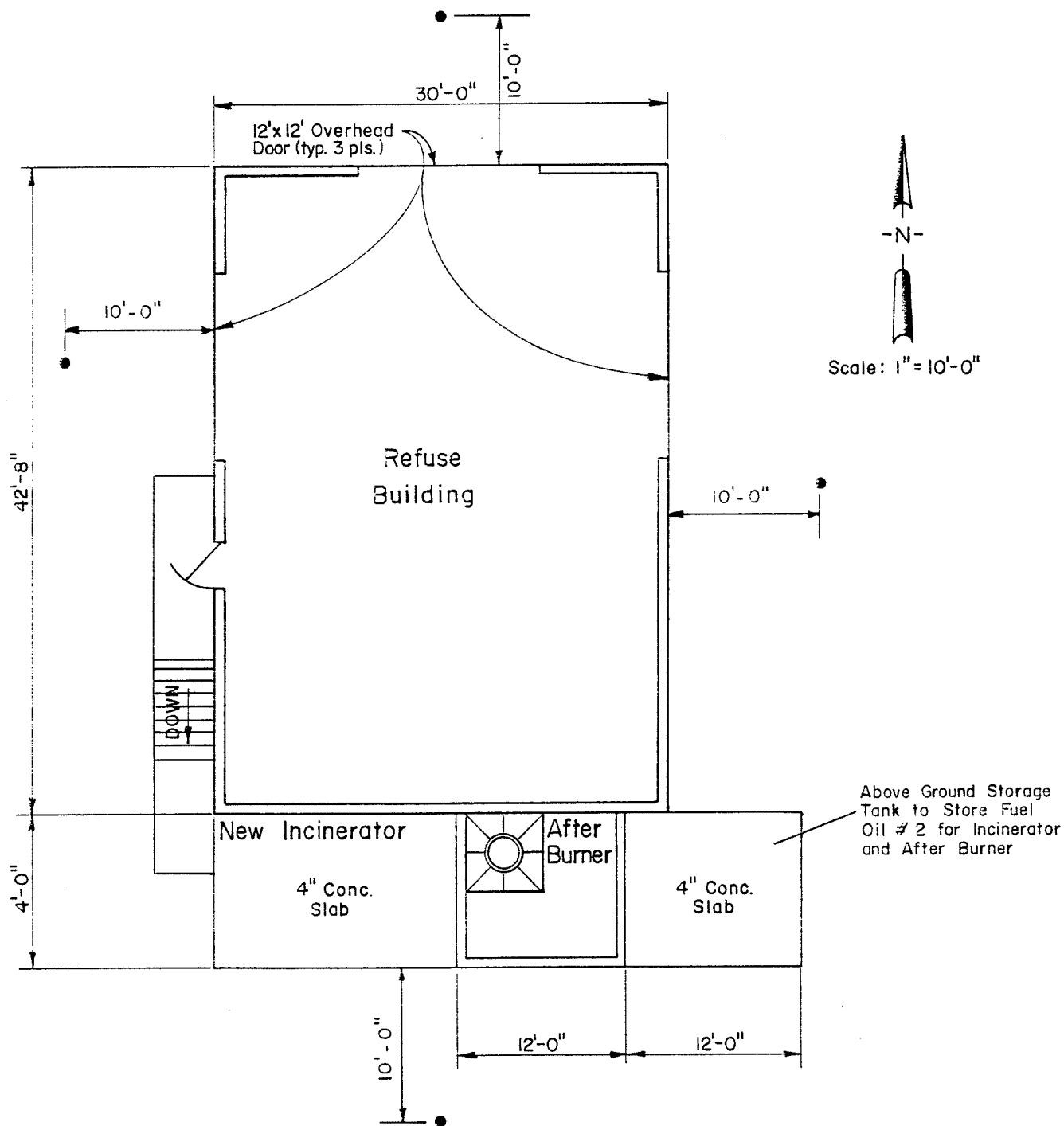
JPG-008 is an open waste pile on an abandoned airport runway. JPG receives pentachlorophenol (PCP)-treated wood for use. This wood is stacked in piles and as pallets and crates in this area, and disposed off-post in a sanitary landfill.

4.1.7.1 Proposed Action

No recommended action.

4.1.8 Building 333 (New Incinerator) - JPG-011

The new incinerator covers an area of about 1,280 square feet, and operates with a single chamber (Figure 4.4). The incinerator



LEGEND

- Approximate Location for Proposed Soil Samples

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FIGURE 4.4

Building 333 - New Incinerator

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operates with Type II fuel oil and has an after burner. The incinerator building, has been in operation since 1978. The incinerator has been used to burn primarily paper and paper products. In 1988-89, polyurethane foams and wastes containing iron oxide were incinerated and the ash was characterized and appropriately disposed.

4.1.8.1 Proposed Action

To assess the level of contamination that may be present in the new incinerator, wipe samples of the incinerator stack and interior should be collected and analyzed for TCLP heavy metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se). The analytical results will determine whether or not equipment decontamination is necessary before the building is released for unrestricted use.

Approximately four (4) soil samples, one from each side of the building, from 0 to 6" below land surface (bls) should be collected and analyzed for TCLP metals (Ag, As, Ba, Cd, Cr, Pb, Hg, and Se).

4.1.9 Old Fire Training Pit - JPG-030

JPG-030 is an unlined 200 square foot, 2 feet deep open pit in which wood debris was routinely soaked with diesel and other petroleum products, and ignited. Fire fighters then extinguished the resulting fire as part of their training program. The

environmental concern here is that heavy metals (primarily lead) and unburnt petroleum products could be adsorbed onto the surface deposits. Unburnt petroleum products could migrate to the ground water which is approximately 20 feet below the surface. In addition, contaminants could be transported during surface water runoff, especially when heavy rains cause the training pit to overflow. The old fire training pit is no longer used, but the soil has not been characterized.

4.1.9.1 Proposed Action

Five (5) surface grab samples should be collected from areas which are oil stained and analyzed for TPH, BTEX, Halogenated Organic Compounds (HOCs), TCLP for lead, and PCBs.

Approximately two subsurface soils should be collected at (0-2) foot and (2-5) foot intervals and analyzed for TPH, BTEX, HOCs, TCLP for lead, and PCBs. Similar analysis has been in the U.S. Army Environmental Hygiene Agency (AEHA) Ground Water Contamination Survey Report (August, 1988). A ground water monitoring program should be undertaken only after reviewing the analytical results of soil samples collected. Water standing in the pit should be sampled (one sample) and analyzed for the same parameters to determine appropriate disposal options.

4.1.10 Building 305 (Temporary Storage) - JPG-036

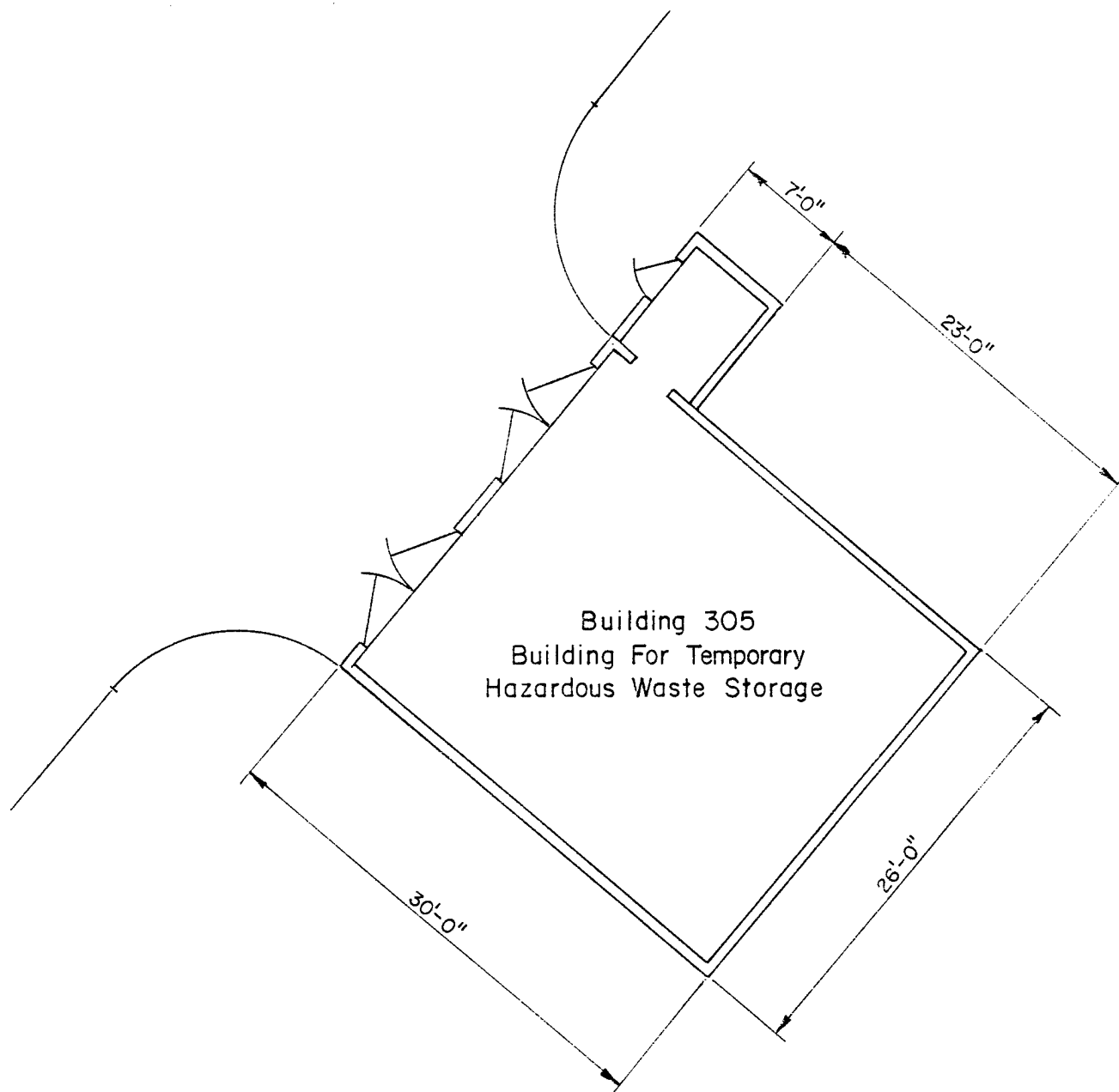
Building 305 is approximately 25 feet x 30 feet with metal siding (Figure 4.5). JPG has used this building since 1980 for temporarily storing hazardous wastes prior to off-post disposal. Some of the wastes stored include spent paint thinner, spent TCE, Stoddart solvent (Type II), PCB-contaminated oil, transformers, copper, salts, double bagged asbestos, and bagged ash residue from open burning operations. All these wastes are properly stored.

There is no evidence of release to the environment. The potential for migration or disposal of hazardous wastes is limited to a major spill event. Proper handling and safety measures will limit the potential for human exposure.

4.1.10.1 Proposed Action

Currently, the building operates under RCRA interim status. JPG has submitted a closure plan to USEPA and the State of Indiana. If this closure plan is approved, it should be implemented as part of the facility closure plan.

Wipe and chip samples of interior surfaces of the building and loading ramp area should be collected and analyzed for specific constituents to determine if decontamination would be necessary



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FIGURE 4.5
Building 305-
Temporary Hazardous Waste Storage

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prior to release. The analytical parameters are PCBs, HOCs and TCLP for lead, mercury and barium.

4.1.11 EO Contamination South of the Firing Line

The area south of the firing line has EO in the ground at various locations. The EO most likely come from the rocket, mine and armor plate testing as well as ammunition dumping that took place during the World War II era. Several 60mm mortar rounds were encountered during excavation activities near the main gate.

Few records indicate the firing position or impact areas used in ordnance testing south of the firing line. Therefore, the location of EO in this area is poorly defined. High explosive rounds (HE) and safe shells (marked SS) are rarely recovered after they have been fired because of the extreme hazard associated with this activity. In many cases the markings on the shells have worn off. In such cases, the high explosive shells cannot be distinguished from safe shells. Some hunters have reportedly identified EO in hunting areas south of the firing line. Because of the extreme physical hazard EO presents, and because their locations are poorly defined, virtually all the area south of the firing line should be considered as potentially containing unexploded ordnance.

In addition, cracked EO have the potential to release hazardous materials into the ground water.

Limited published data exist on the toxicological effects of explosives or water containing explosives on animals (Organic Explosive and Related Compounds: Environmental and Health Considerations, Elizabeth P. Burrows, et al., Technical Report 8901, U.S. Army Medical Bioengineering Research and development Laboratory, Detrick, Fedderic, MD). This report is a compendium of information collected from open literature on the behavior and fate of selected explosives (TNT, DNT, HMX, RDX, Ethylene glycol dinitrate, diethylene glycol dinitate, PETN, tetryl, nitroguanidine, ammonium picrate/picric acid and propylene glycol dinitrate) in the environment. A discussion of biological effects and the potential for animal and health concerns are also discussed. Health advisory standards are available on selected explosives such as trinitroglycerol (TNG), but these are based on clinical studies (Trinitroglycerol, Health Advisory, Office of Drinking Water, U.S. Environmental Protection Agency, September 25, 1987), and may not be appropriate for the mechanism of exposure applicable for JPG. The explosives commonly used at JPG are trinitrotoluene (TNT), TNG, nitroguanidine and nitrocellulose.

4.1.11.1 Proposed Action

The EO south of the firing line should first be located so that a comprehensive plan to remove them may be developed. A soil sampling program can also be developed once the majority of the EO

are located. The soil samples should be analyzed for explosives residues such as TNT, DNT, RDX, HMX, HNS, nitrocellulose, nitroguanidine, tetryl, and TCLP for metals (As, Ba, Cd, Cr, Pb, and Hg). The samples should be screened for explosive residues using a GC scan and only those identified in the scan should be analyzed in detail and quantified. If the soils are determined to be contaminated, a ground water monitoring program should be initiated.

4.1.12 Yellow Sulfur Disposal Area

During the Ebasco Enhanced PA site visit, field team personnel identified a yellow sulfur-like material in an area south of the new incinerator. A drainage ditch is also located very close (within 30 feet) to where the sulfur-like material is located. JPG collected samples and had this material chemically analyzed. The material contains sulfur and 5 out of 8 samples analyzed had a pH of less than 2. This area was further excavated to a depth of 3-5 feet below the surface. More rocks stained with a yellow color were found. In the past, this area may have been another solid waste management unit.

4.1.12.1 Proposed Action

There is evidence of stressed vegetation (probably from low pH) in the immediate vicinity of the disposal area. Soil samples

(approximately 15) should be collected from this area at depths of 0-2 ft and 2-5 ft and analyzed for sulfur, pH and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). The exact number and location of the samples should be determined from field inspection. The surface water in the drainage ditch should also be sampled and analyzed for the same constituents.

4.1.13 Burn Area South of New Incinerator

Near the Yellow Sulfur Disposal Area, EBASCO field personnel also identified a burned area on the ground surface, south of the new incinerator. In addition a concrete pad area which had conduits containing electrical wiring materials, and the surrounding grassy area showed evidence of burning activity. Copper wires and other materials had reportedly been burnt on the concrete pad.

4.1.13.1 Proposed Action

A detailed investigation of this area is required. This should include surface and subsurface soil sampling at five locations to be determined from field inspection. These soils should be analyzed for the presence of TCLP metals (Ag, as, Ba, Cd, Cr, Pb, Hg and Se).

4.2 SOUTH OF THE FIRING LINE (EAST SIDE)

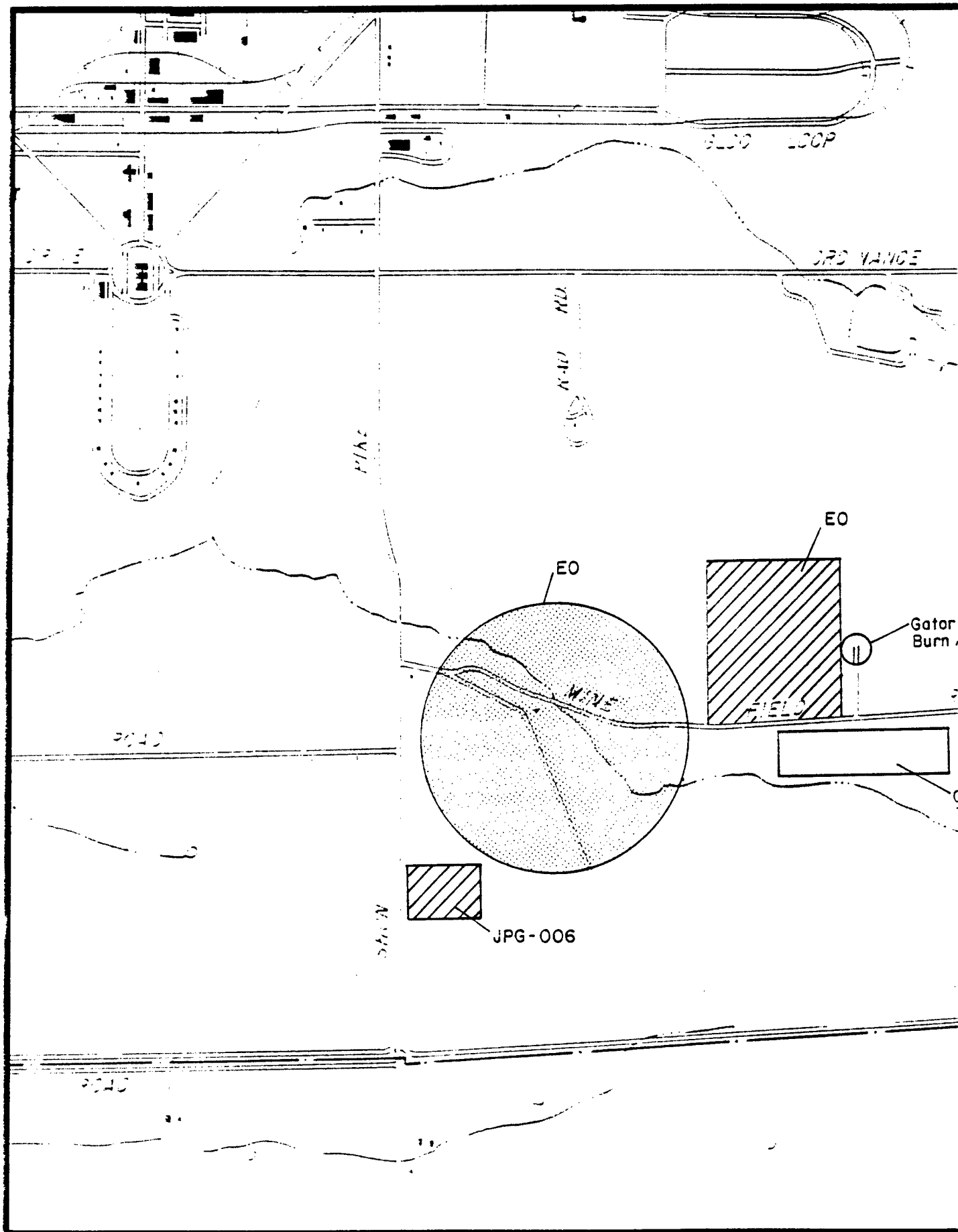
This area contains one solid waste management unit (SWMU). In addition, there are three areas requiring environmental evaluation, south of the firing line on the east side (Figure 4.6).

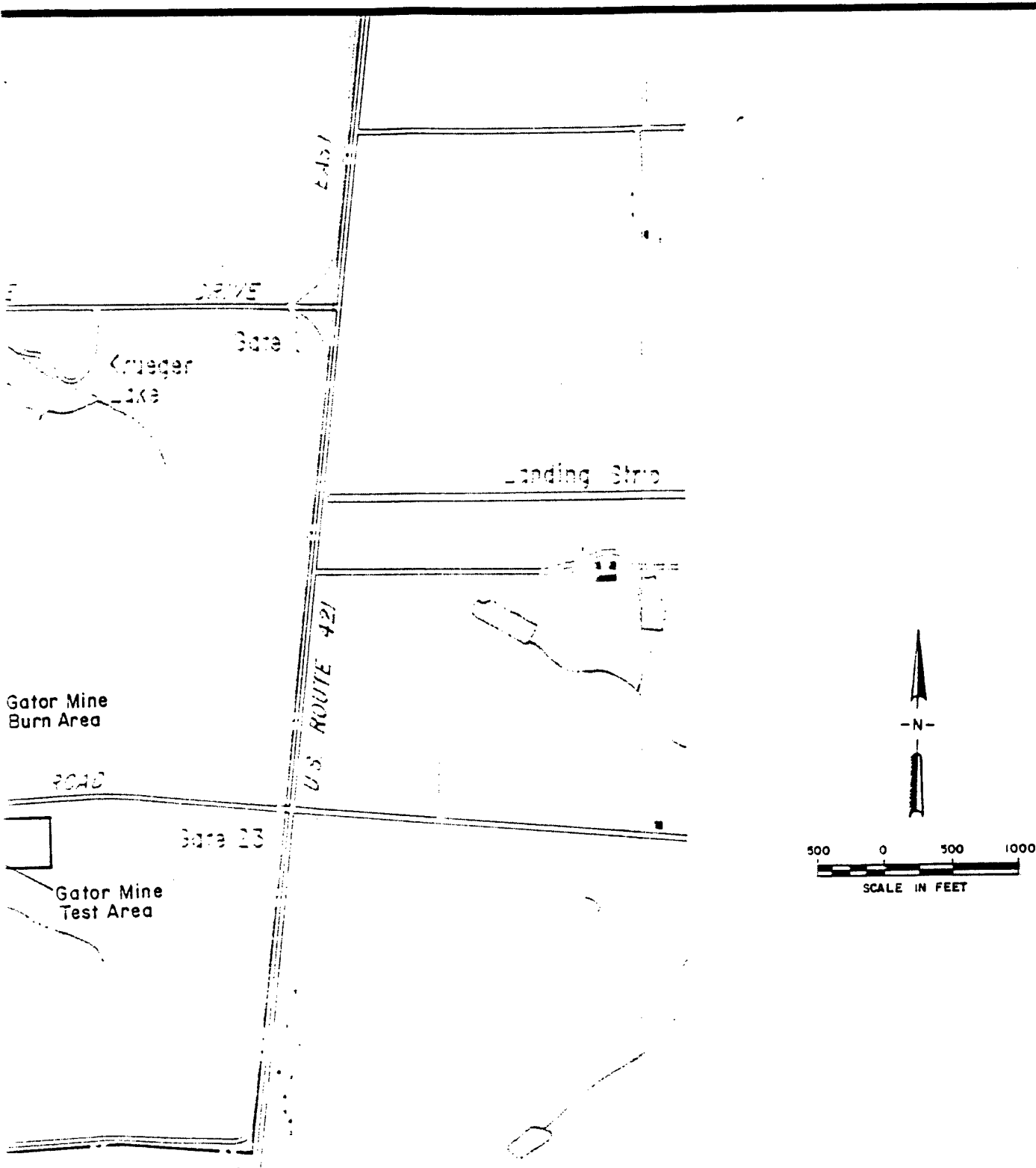
4.2.1 Open Burning Area - JPG-006

This burning area has been used for burning approximately 60,000 lbs. per year of waste and unused/unusable propellant that is not safe to incinerate. Currently, the burning is conducted on trays with locking stainless covers. The resulting ash is appropriately disposed after being analyzed for hazardous characteristics. In the past open burning was performed on the ground and no soil samples have been collected from these burn areas.

4.2.1.1 Proposed Action

The U.S. Army Environmental Hygiene Agency's (AEHA) Ground Water Contamination Survey Report (August, 1988) recommended soil sampling at 1 foot and 5 feet below the surface to check for TCLP metals (As, Ba, Cd, Cr, Pb, and Hg) and explosive residues such as TNT, DNT, HMX, RDX, HNS, tetryl, nitrocellulose and nitroguanidine. This recommendation should be implemented.





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FIGURE 4.6

JPG-006, EO Contamination, Gator Mine
Testing Area, Gator Mine Burn Area

The samples should be screened for the specific explosive residues, using GC scan, and only those identified in the scan should be analyzed in detail and quantified.

4.2.2 EO Contamination

Our recommendations for EO contamination are the same for the east side as the west side. Please see Section 4.1.11 for details.

4.2.3 Gator Mine Testing Area

This area is used for testing mines. The contaminants of concern are the heavy metals and explosive residues that could potentially leach through soils to the ground water. No soil sampling has been conducted in this area.

4.2.3.1 Proposed Action

A soil sampling program should be developed and implemented to check selected soil samples for TCLP metals (As, Ba, Cd, Cr, Pb, and Hg) and explosive residues. Approximately 10 samples should be collected from at least two different depths (0-2 ft and 2-5 ft) below the surface at five locations to be determined from field inspection.

4.2.4 Burn Pile at Gator Mine Testing Area

This is an area (located north of the Gator Mine Area) where scrapwood, wire, and plastic is periodically burned. These materials constitute most of the debris removed from the Gator Mine pits. They are stored in this area across the road until the pile is large enough to burn.

4.2.4.1 Proposed Action

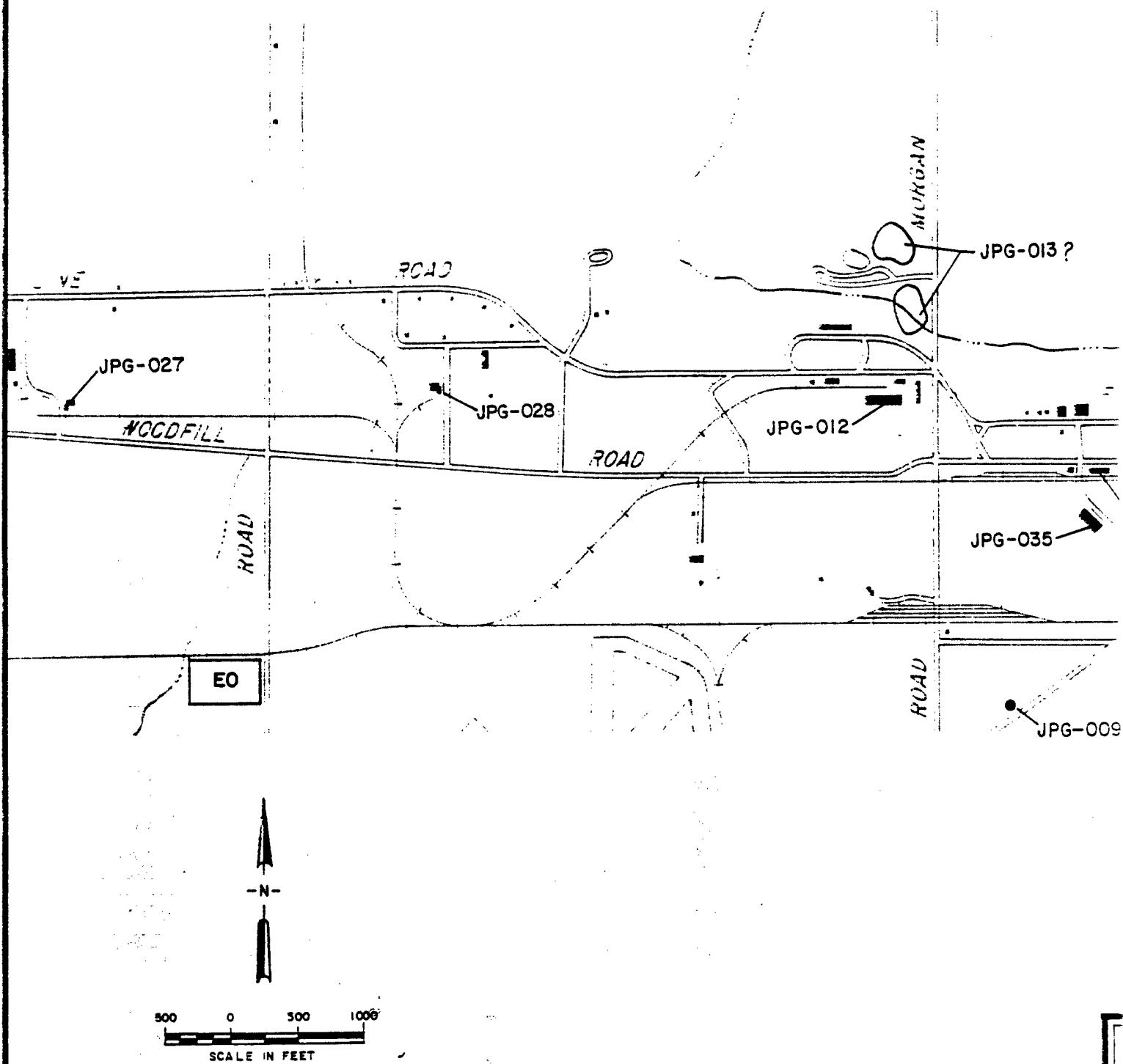
No soil sampling data is currently available. Soil from stained areas should be sampled and analyzed for TCLP metals and explosive residues. The number (up to five) and locations of the samples should be determined from field inspection.

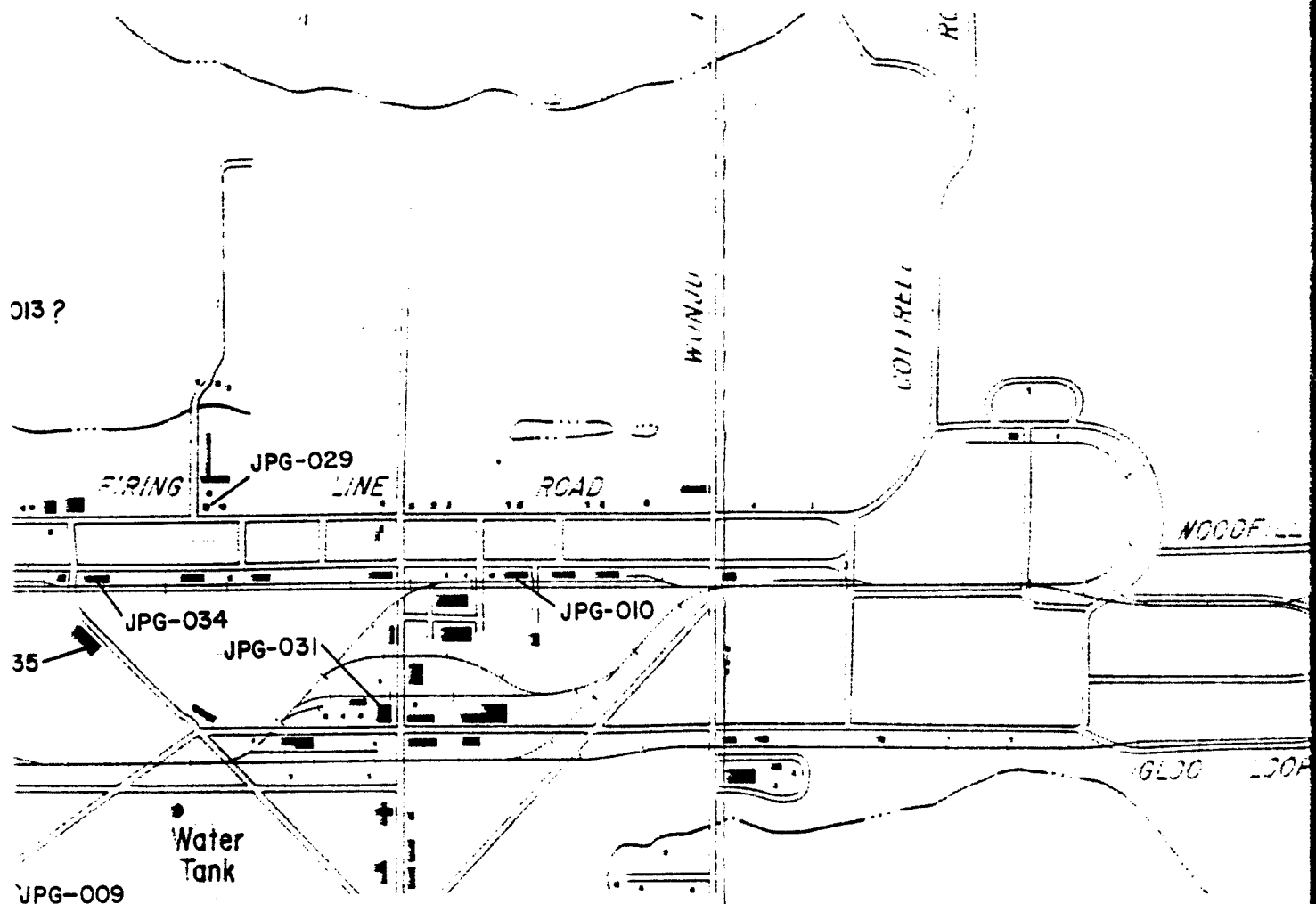
4.3 FIRING LINE AREA

This area contains twelve (12) Solid Waste Management Units (SWMUs) (Figure 4.7). Two of the SWMUs (JPG 032 and 033) are not shown in Figure 4.7 because their location is presently unknown. In addition, one area of environmental concern was identified.

4.3.1 Red Lead Disposal Area - JPG-009

This area was reportedly the designated area to dispose paint residues and inert fillers. The inert fillers contained lead oxide (red lead). In addition to this area, red lead was reportedly





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FIGURE 4.7

JPG-009, 010, 012, 013, 027, 028, 029, 031
034, 035, Ammunition Assembly Area

disposed of at other areas as well. Red lead disposal at JPG-009 occurred between 1952-1958 and between 1961-1978.

4.3.1.1 Proposed Action

These areas should be properly located and delineated. Once this is done, soils and nearby surface water should be sampled and analyzed for TCLP metals (As, Ba, Cd, Cr, Pb, and Hg). If the soils are shown to be contaminated, monitoring wells should be installed around the area to check for migration of lead to the ground water. At least one well should be installed up gradient and three wells down gradient of the site. The ground water samples from these wells should be analyzed for the same parameters as the soil samples.

4.3.2 Building 208 - JPG-010

This building is a 4,929 square foot photographic laboratory used for processing, developing and printing large quantities of black and white and color film for JPG activities. The laboratory has been in operation since the mid 1970s. In the past waste-toners and silver-bearing developers were directly discharged to the sewer system. Currently, a silver recovery system is in place and the laboratory operates in an environmentally sound manner.

4.3.2.1 Proposed Action

Approximately three chip and/or wipe samples each of the floors, and drains should be collected. These samples should be analyzed for the presence of silver and cyanides. The results will indicate whether or not decontamination is required.

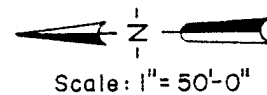
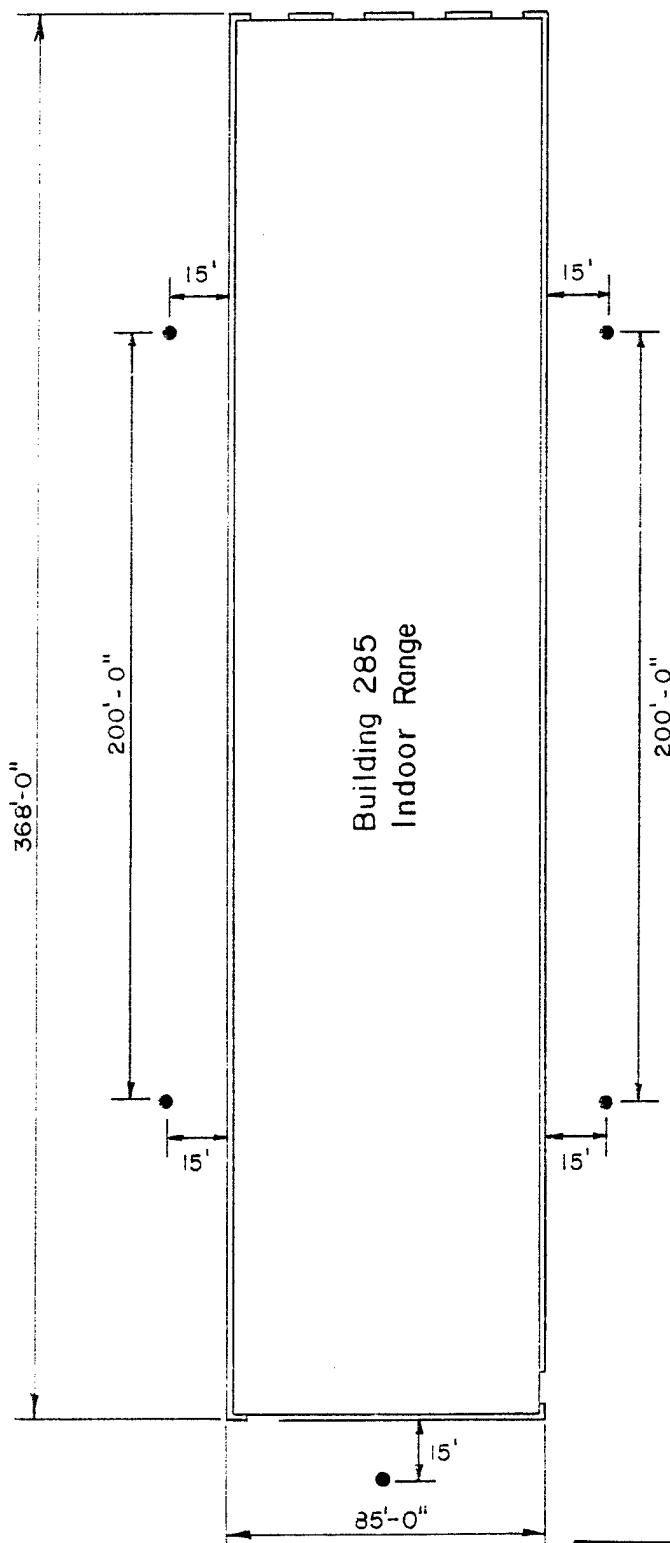
4.3.3 Indoor Range (Building 285) - JPG-012

This indoor range (Figure 4.8) was primarily used to test small arms and for training purposes. The range was closed several years ago due to concerns of lead dust contamination derived from lead bullets used in the range.

4.3.3.1 Proposed Action

Wipe samples of interior surfaces and the HVAC should be collected. Approximately 5 surface soil samples around the building should also be collected. All samples should be analyzed for total lead.

All lead-bearing targets, sand traps, or other materials that are potentially contaminated with lead should be analyzed for lead prior to disposal.



LEGEND

- Approximate Location of Proposed Surface Soil Samples

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FIGURE 4.8

Building 285 - Indoor Range

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Madison, Indiana

4.3.4 Area for Munitions Demilitarization - JPG-013

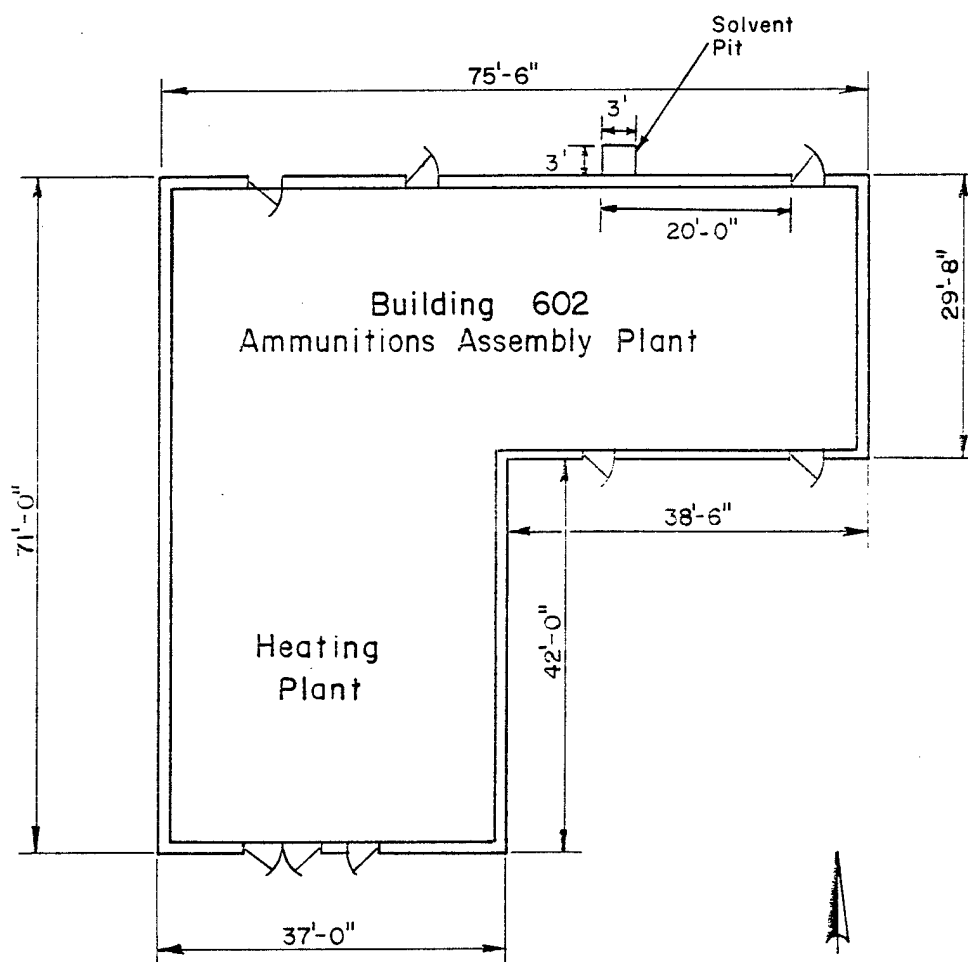
JPG-013 was reportedly an area used for demilitarization of munitions. The size of this area as well as the dates of its use are unknown. Hazardous wastes are suspected to have been disposed in this area, but during site visits no evidence could be obtained to confirm this suspicion.

4.3.4.1 Proposed Action

A work plan should be developed to further investigate this area. This plan should include a geophysical survey using equipment such as ground penetrating radar or magnetometer to locate and define the area. Once the area is defined, soil sampling should be conducted. The soils should be analyzed for explosive residues such as TNT, DNT, RDX, HMX, HMS, nitrocellulose, nitroguanidine and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). If soils are shown to be contaminated, approximately 4 groundwater monitoring wells should be installed to characterize upgradient and downgradient groundwater quality. Water from these wells should be analyzed for the same analytes.

4.3.5 Building 602 (Solvent Pit) - JPG-027

JPG-027 is a cobble-lined solvent pit 9 square foot in area and 4 feet deep (Figure 4.9). This area was used from 1970 to 1978



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FIGURE 4.9
Building 602-
Ammunitions Assembly Plant

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for routinely dumping used solvents and degreasers. This practice is no longer in use.

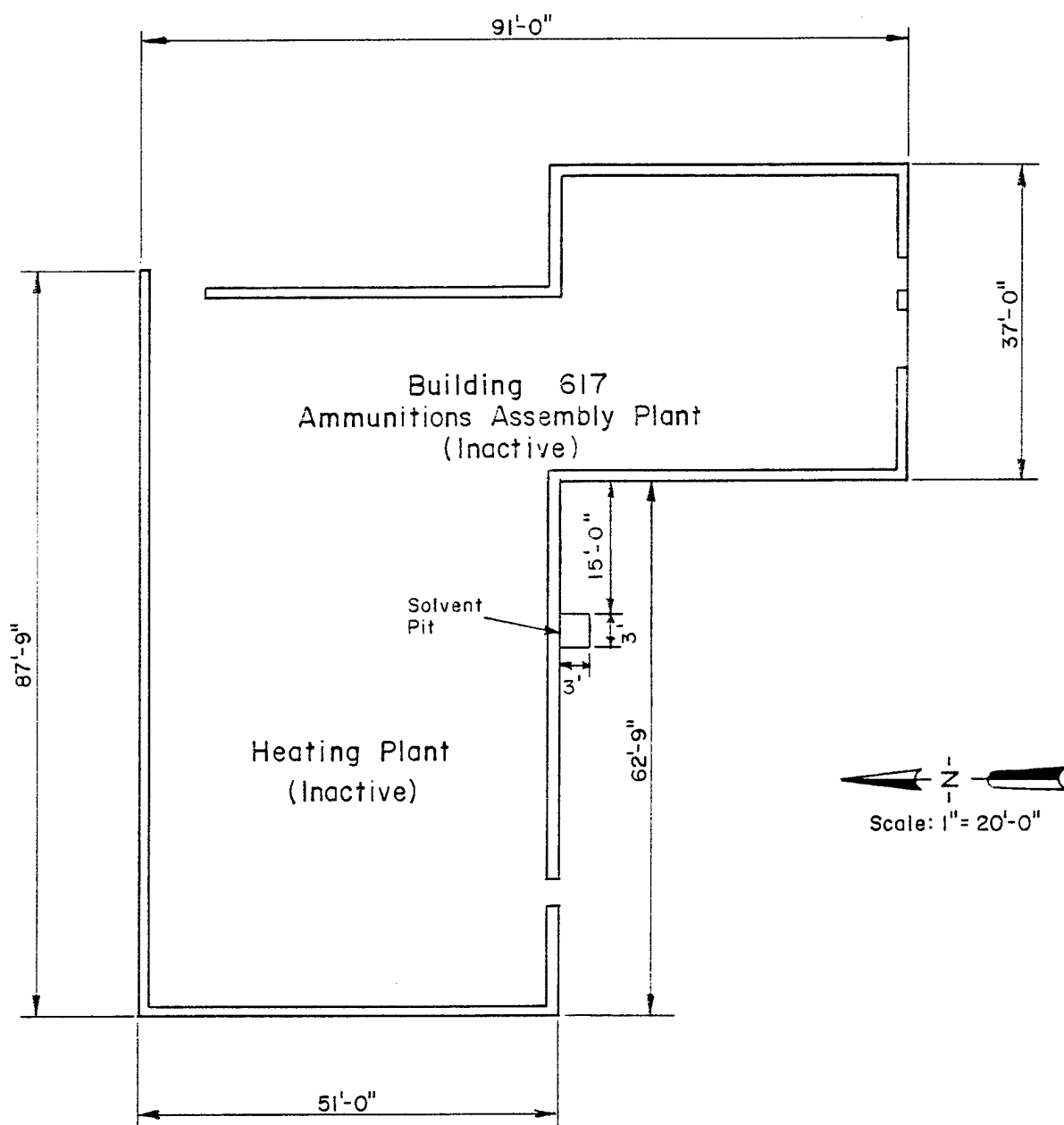
A remedial investigation was performed during 1987 through 1988 to determine if contamination exists. Analytical results from soil samples indicate elevated levels 1,1,1-trichloroethane and 1,2-dichloroethane. Other compounds detected in the soil samples include acetone, 1,1-dichloroethane, 1,1,2-trichloroethane, toluene and trichloroethylene. Shallow ground water occurs at approximately 20 to 25 feet in the area. The contaminants are expected to reach the water table. The lateral extent of contamination is unknown.

4.3.5.1 Proposed Action Plan

The recommendations outlined in the Remedial Investigation Technical Report A011, 1989 are appropriate and should be implemented. This report suggests that three (3) shallow monitoring wells be installed around the building and one additional well down gradient of the source areas.

4.3.6 Building 617 (Solvent Pit) - JPG-028

JPG-028 is also a 9 square foot, 4 foot deep cobble-lined solvent pit that was used from 1970 to 1978 to routinely dump spent solvents and degreasers (Figure 4.10). This practice has been



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FIGURE 4.10
Building 617-
Ammunitions Assembly Plant (Inactive)

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Madison, Indiana

discontinued. A Remedial Investigation was conducted in this area to determine if soil is contaminated. Soil gas samples obtained during the investigation showed that total VOC concentrations exceeded 4 $\mu\text{g/g}$. The VOCs detected were acetone, benzene, chloroform, 1,1 dichloroethane, 1,2 dichloroethane, 1,1-dichloroethene, 1,2 dichloroethene, toluene, 1,1,1-trichloroethane and trichloroethylene.

The shallow ground water is expected to be at 20 to 25 feet in this area. The key environmental concern is the potential for ground water contamination from the VOCs present in the soil. The Remedial Investigation Technical Report A011, 1989 discusses the details and the results of the investigation.

4.3.6.1 Proposed Action

The proposed action plan for this area is the same as that recommended in the Remedial Investigation Technical Report A011, 1989. This consists of installing three (3) shallow monitoring wells around the building and one additional well downgradient of the source areas.

4.3.7 Building 279 - JPG-029

JPG-029 is also a 9 square foot, 4 foot deep cobble-lined solvent pit which was used from 1970 to 1978 for dumping spent solvents

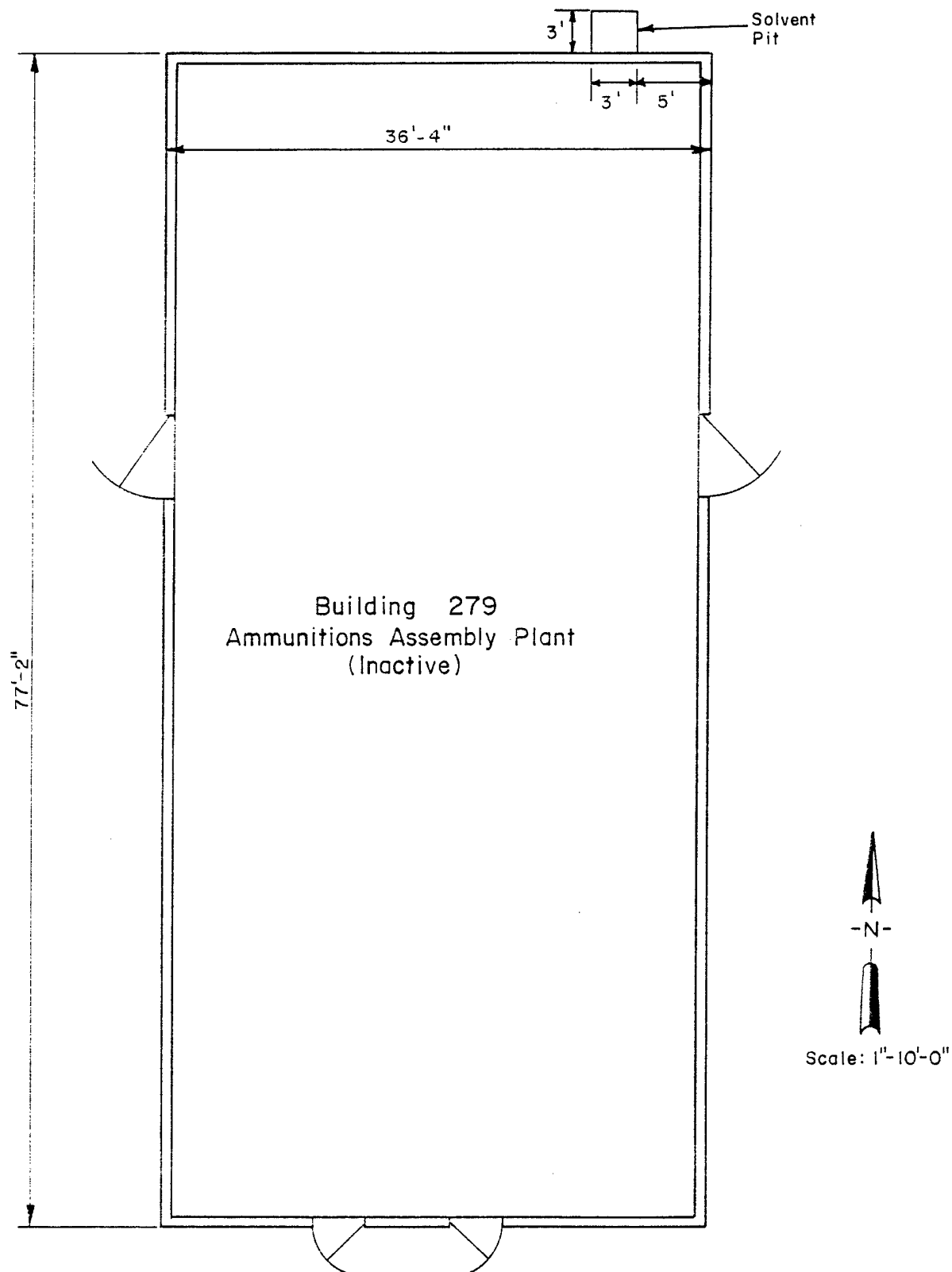
and degreasers (Figure 4.11). This pit is no longer in use, but the environmental concerns regarding the pit are the same as for JPG-027 and JPG-028. The Remedial Investigation conducted from 1987 through 1988 on JPG-027 and JPG-028 also includes JPG-029. In addition, three ground water monitoring wells were installed in the vicinity of JPG-029 and sampled. VOCs (1,1-dichloroethane, 1,1,1-trichloroethane, and trichloroethylene) were detected in the water sampled from one well located within 10 feet of the pit. Samples from the other two wells located down gradient showed no VOC contamination. These results indicate that the contaminants have not migrated significantly.

4.3.7.1 Proposed Action

A ground water sampling and analysis program should be initiated for one year on a quarterly, and for five additional years on an annual basis to track the movement of contaminants that have already migrated. These samples should be analyzed for the volatile organics detected during the previous remedial investigation. These include 1,1 dichloroethane, 1,1,1-trichloroethane, and trichloroethylene.

4.3.8 Building 105 (Temporary Storage) - JPG-031

JPG-031 is a large metal shop/industrial-type facility where waste fluids such as cutting oil, cooling fluids, and naphthalemic oils



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FIGURE 4.11
Building 279-
Ammunitions Assembly Plant (Inactive)

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JEFFERSON PROVING GROUND
Madison, Indiana

are temporarily stored before they are properly disposed (Figure 4.12). There are no environmental concerns associated with the activities conducted inside this building. The potential for any release of waste fluids is limited to a catastrophic spill.

4.3.8.1 Proposed Action

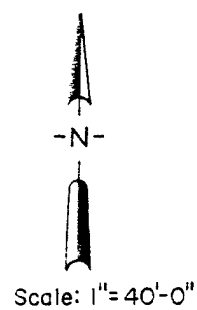
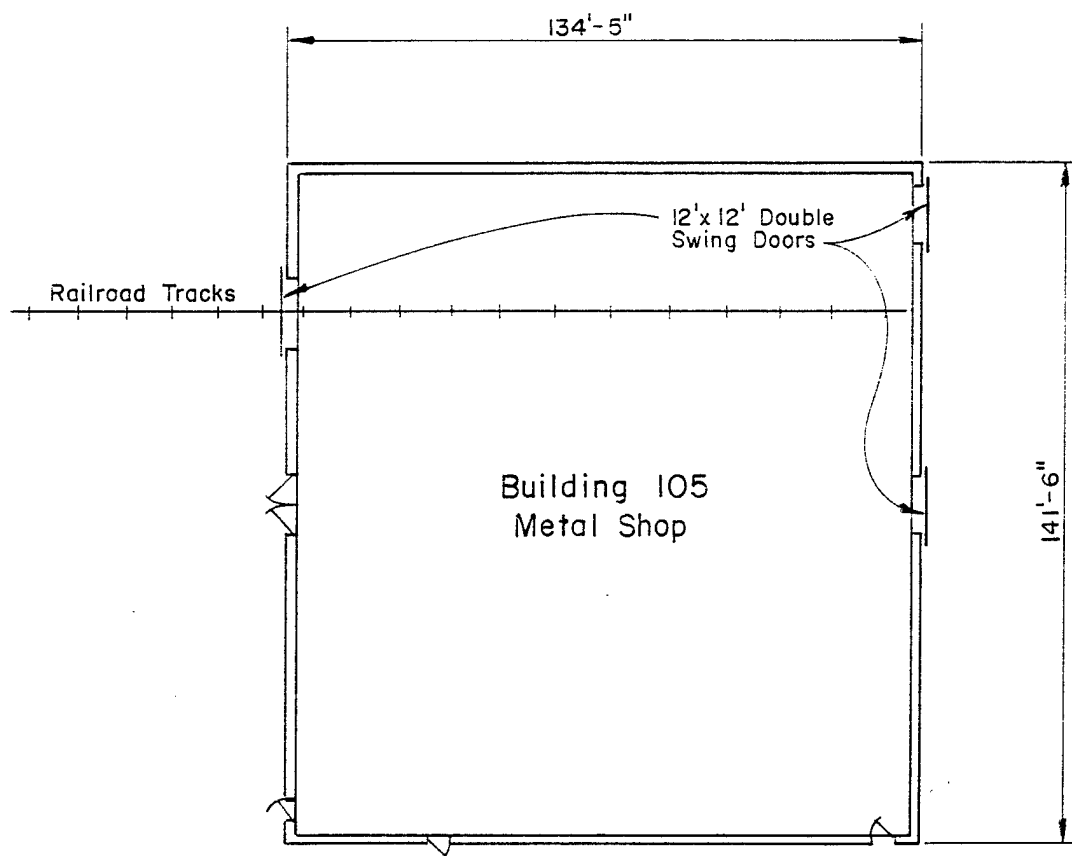
Wipe and/or chip samples of interior surfaces, subfloor and floor drains should be collected and analyzed for PCBs. The results would indicate whether or not decontamination is required.

4.3.9 Temporary Storage - JPG-032

JPG-032 was an area reportedly used for temporary storage. The size of this storage area, the type of materials stored, or the potential contaminant release mechanisms are currently unknown.

4.3.9.1 Proposed Action

Locate the temporary storage area and identify items/materials stored. Reviewing aerial photographs or conducting geophysical surveys using equipment such as ground penetrating radar, resistivity or conductivity meter are some of the suggested methods to investigate this area.



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FIGURE 4.12
Building 105 - Metal Shop

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JEFFERSON PROVING GROUND
Madison, Indiana

4.3.10 Temporary Storage - JPG-033

JPG-033 was also an area reportedly used for temporary storage. Like JPG-032, no information is currently available on the size of the storage area, the type of materials stored or the potential contaminant release mechanisms.

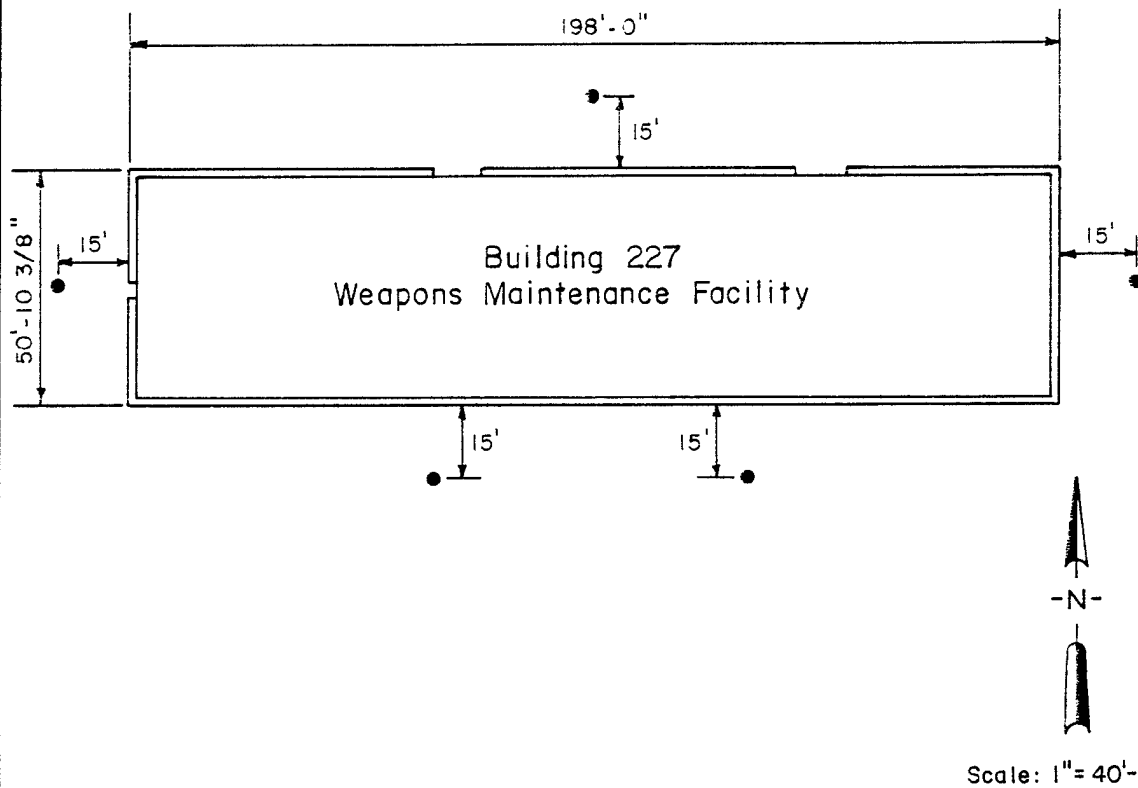
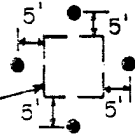
4.3.10.1 Proposed Action

The proposed action is the same as that recommended for JPG-032 (see section 4.3.9.1 above).

4.3.11 Building 227 (Temporary Storage) - JPG-034

JPG-034 is a large brick weapons maintenance facility used for repairing and refurbishing large gun tubes and other weapons or weapon parts (Figure 4.13). Since January 1990, waste solvents and oils have been stored in a conforming storage immediately outside this building in drums and containers until they are picked up by a private contractor for proper disposal. Before January 1990, waste solvents, paints and oils were stored in drums and containers and placed in a metal shed until they are picked up by the DRMO contractor.

Shed 11
Old Storage
Area



LEGEND

- Approximate Location of Proposed Soil Samples

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FIGURE 4.13
Building 227
Weapons Maintenance Facility

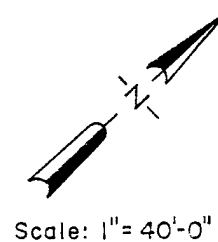
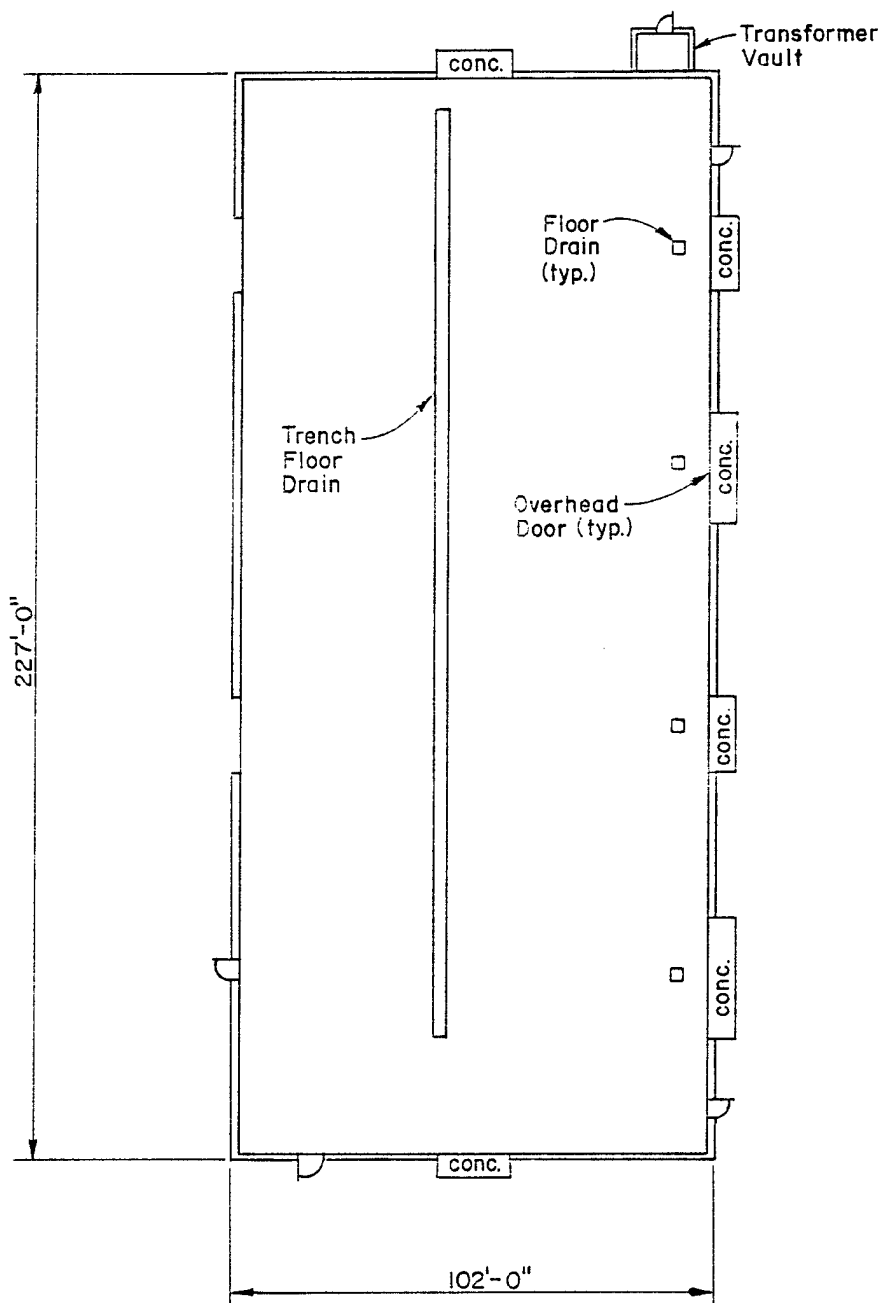
MASTER ENVIRONMENTAL PLAN
JEFFERSON PROVING GROUND
Madison, Indiana

4.3.11.1 Proposed Action

A perimeter inspection should be undertaken and areas of obvious soil staining should be sampled. In addition, approximately four (4) surface soil samples should be collected from locations around Shed 11 (the old storage shed). Wipe and/or chip samples of the interior surfaces and drains should also be collected to determine the need for decontamination. All samples should be analyzed for halogenated organic compounds, and heavy metals (As, Ba, Cd, Cr, Pb and Hg).

4.3.12 Building 186 (Temporary Storage) - JPG-035

JPG-035 is a large warehouse used as a maintenance garage for repairing heavy equipment and vehicles (Figure 4.14). This building is also used to temporarily store materials such as Type II Stodard Solvent, and No. 1 fuel oil in above ground storage tanks. Empty drums and used batteries are temporarily stored outside the building on pallets until they are picked up and properly disposed. This storage area is also partially bermed. Used oil is stored in an underground storage tank located south of the building and the contents are removed in a proper manner.



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FIGURE 4.14
Building 186
Maintenance Garage

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JEFFERSON PROVING GROUND
Madison, Indiana

4.3.12.1 Proposed Action

Wipe and/or chip samples of interior surfaces, the HVAC system and floor drains should be collected and analyzed for heavy metals (As, Ba, Cd, Cr, Pb and Hg).

A site inspection should be conducted. Areas of obvious soil staining should be sampled. In addition, approximately five (5) surface soil samples from the building perimeter should be collected and analyzed for the same heavy metals.

4.3.13 Ammunition Assembly Areas

Several buildings at JPG are used for assembling munitions. The projectiles assembled contain powdered explosives assembled under stringent safety protocols. There are no environmental concerns associated with the activities conducted in these areas. However, explosive residues may be present on floors and ceilings, and in building HVAC systems. No sampling for these residues has been performed.

4.3.13.1 Proposed Action

As part of the JPG closure procedures, a limited sampling of the floors and ceilings will be necessary to document that they are

free from explosive residues. Wipe samples of the interior surfaces and HVAC should be collected and analyzed for explosives and heavy metals.

4.3.14 Ammunition Storage Igloos

Ammunition for testing programs is stored in igloos which are located toward the east end of the firing line, on Igloo Loop Road. While these are not considered to be SWMUs or AREE, there is a slight potential that they may contain explosive and propellant residues.

4.3.14.1 Proposed Action

Wipe samples of igloo interiors and drains (if they exist) should be collected and analyzed for the presence of explosive residues such as TNT, DNT, RDX, HMX, HMS, tetryl, nitrocellulose, nitroguanidine, and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). A GC scan may be used to identify the explosives. Only those identified in the scan need to be analyzed in detail.

4.3.15 Pesticide Storage Building

This building is used for storing pesticides.

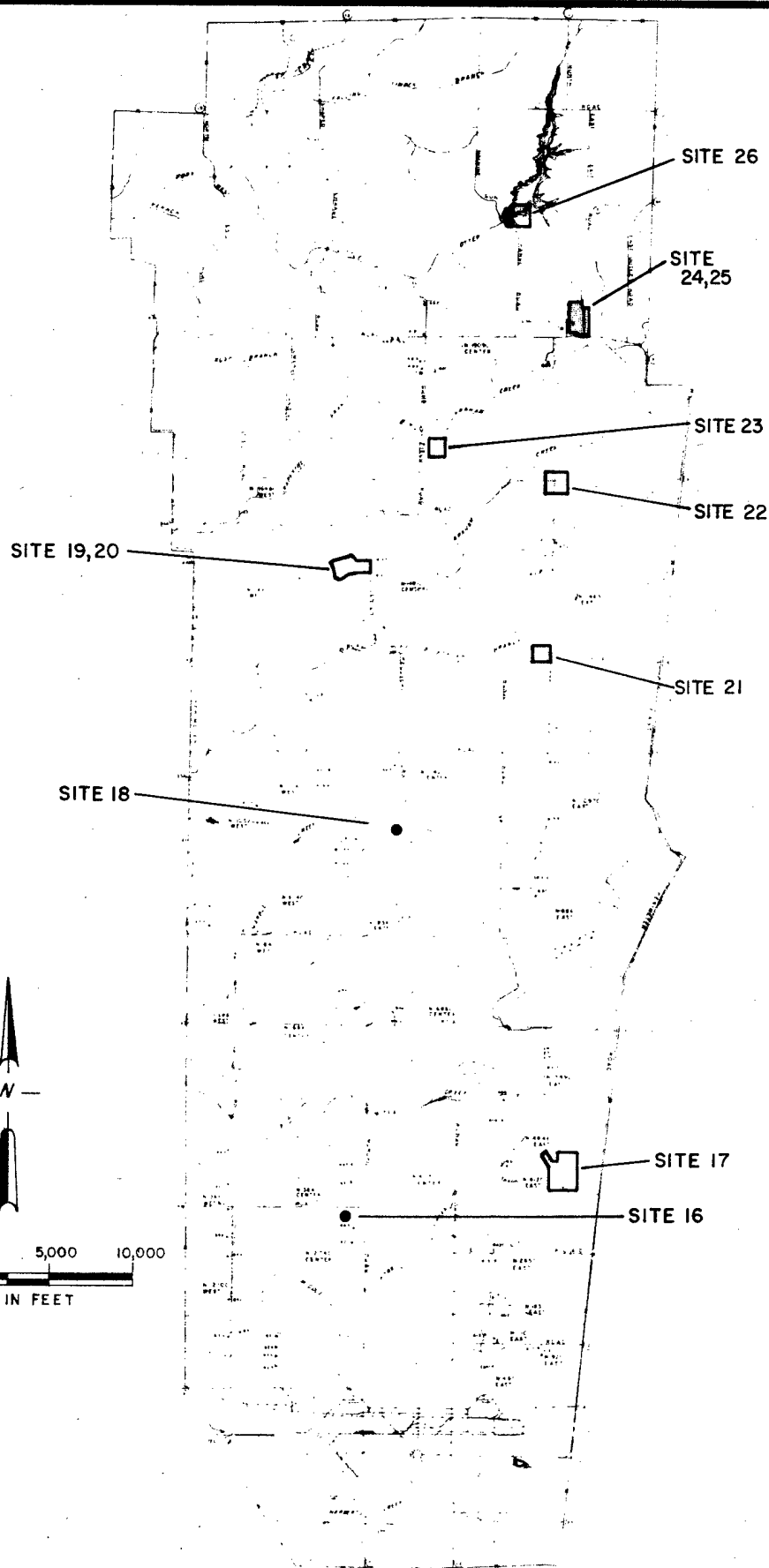
4.3.15.1 Proposed Action

Collect wipe samples of building interior surfaces and drains. Collect approximately four (4) soil samples from around the building. All samples should be analyzed for pesticides.

4.4 NORTH OF THE FIRING LINE

There are eleven (11) SWMUs and two (2) additional sites identified north of the firing line (Figure 4.15). In addition, all presently used impact areas and targets are located north of the firing line. This area comprises most of JPG; approximately 50,000 of the 55,265 acres.

There is very little known about the specific geology/hydrogeology of this portion of Jefferson Proving Ground. The soil has a low to moderate permeability with the deeper clays being fairly impervious, thus slowing the migration of potential contaminants. The permeability of one (1) soil sample was found to be 0.11 cm per day; this value indicates a low migration rate. Low permeability soils allow for the collection of standing water. Limestone and shale bedrock can be observed at cut banks and in stream beds, however, no specific study of the structures, joints, fractures, permeabilities, and ground water occurring in the bedrock has been conducted to date.



Key

- 16 Ordnance Disposal Site
- 17 Landfill
- 18 Abandoned Well
- 19 Munition Test Pond
- 20 Macadam Test Pond
- 21 Abandoned Well
- 22 Disposal Site
- 22 Burning Area for Explosive Residue
- 23 Demolition Ground
- 24 Landfill
- 25 Landfill
- 26 Landfill

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FIGURE 4.15

Locations of 11 SWMUs

All survey, sampling, and drilling activities conducted in areas north of the firing line must be done under the direction and guidance of JPG EOD officers. There is a possibility that live rounds were disposed of in the landfills and ordnance disposal sites, and that other SWMUs and areas requiring environmental evaluation may be contaminated with EO from testing programs. Any intrusive activities performed in these areas must be done with extreme caution. Remote drilling methods should be used for installing boreholes and for soil sampling (split spoon/shelby tube) during drilling activities.

4.4.1 Ordnance Disposal Site - JPG-016

This disposal site which is approximately 60 square feet in size and was used for the disposal of munitions related components, including chemical explosives. The site is a water-filled pit which contains ordnance. Over time lead, chromium, TNT, and/or DNT may enter the surrounding water and soils. The physical hazard that the shells represent is the most significant concern. The potential for these shells to detonate is unknown.

4.4.1.1 Proposed Action

One (1) surface water sample from the pit and approximately four soil/sediment samples from around the pit must be sampled to

analyze the impact that the disposal of these materials has had on the surrounding environment. The soil borings should be advanced to a depth below that of the disposal pit; the soils should be continuously sampled. Because it is not known if all components placed in this disposal area are inert, great care must be exercised when sampling the surface water; contact with, and/or disturbance of the shells may cause detonation. Water and soils should be analyzed for explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine). A GC scan may be used for initial identification of the contaminants detail analyses.

If surface water and soils analyses show significant concentrations of the analytes in question, ground water monitoring wells should be installed. Approximately four wells will be used to characterize both the upgradient and downgradient water quality. Ground water from these wells should be sampled and analyzed for explosive residues such as TNT and DNT and heavy metals (As, Ba, Cd, Cr, Pb and Hg).

4.4.2 Landfill - JPG-017

The abandoned landfill, located just off B Road, is of unknown depth. The landfill was used from the early 1960's to 1981 for the burial of inert munitions-related materials from firing range and testing activities. Buried wastes and water-filled pits containing inert shells make up this 8-acre site. Metal plates have been

placed over sections of the landfill as truck turnarounds. The landfill is overgrown and barely visible. The materials in the landfill may contain explosives or other hazardous constituents. Ground water is apparently shallow in this area, and may be a release pathway to the environment.

4.4.2.1 Proposed Action

To assess this solid waste management unit, the exact limits of the landfill must be known. A geophysics survey, composed of ground probing radar, surface resistivity, and magnetometry, can meet this requirement. Once the limits of the landfill are established, soil and surface waters in and around the landfill should be sampled and analyzed for explosives, explosive by-products, and heavy metals. Approximately four (4) soil borings per acre should be drilled and soils samples should be collected from 0-2 ft and 2-5 ft intervals. The soils should be sampled and analyzed for explosive residues such as TNT, DNT, RDX, HMX, HMS, tetryl, nitrocellulose, nitroguanidine, and TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

If analytical results indicate that the soil is contaminated, groundwater studies may be required. The limits of the landfill should be determined before an effective groundwater monitoring network can be designed and installed. A geophysical investigation using equipment such as a ground penetrating radar, resistivity or

conductivity meter should provide the necessary information to delineate the landfill boundary. Approximately four wells should be installed to characterize both upgradient and downgradient water quality. More may be necessary if local hydrogeologic conditions are complex, or if they are warranted, based on findings from the installation of the initial wells. Sample ground water, analyze for the same parameters as the soil samples.

4.4.3 Abandoned Well Disposal Site - JPG-018

This abandoned water well was used for the disposal of munitions-related materials. The well is hand dug and about 3 feet in diameter with standing water 6 to 10 feet below ground surface. The walls of the well are lined with limestone. Reportedly, 100 to 200 riot control grenades were dumped in this farm well. The well is no longer used for disposal of any type of material. Ammunition can be seen on the ground surface in the vicinity of the well. It is unknown whether the grenades are explosive or not. Over time, the riot control agent (CS/CN) would hydrolyze if released, while the ignitor/pyrotechnic mix and metals may enter ground water. The presence of the grenades and their current condition is the most significant concern. The potential for these grenades to detonate is unknown. Because there is direct contact between the riot control grenades and ground water, it is almost certain that a release to ground water has occurred.

4.4.3.1 Proposed Action

To ascertain the magnitude of the existing contamination, a water sample from the well should be collected and analyzed for the presence of explosives, metals, and riot control agent and its degradation products. In addition to the safety required for the proposed actions mentioned in the above sections, extreme caution must be exercised in sampling the water from this well. The well is located in an area where explosive ordnance is known to exist; artillery shells can be seen on the ground surface (in fact immediately adjacent to the well), and it is not known if the riot control grenades may explode. If the water sample is shown to be contaminated it may be necessary to install a ground water monitoring network to determine the nature and extent of contamination from this source.

4.4.4 Sediment Bottom Munitions Test Pond - JPG-019

This site is a water-filled, unlined munitions test pond. The dam, which is on the western side of the pond, is being washed out at its northern end. This pond was used for the testing of proximity fuses and probably contains munitions-related materials. It is unknown if the shells which are present are explosive, but it must be assumed that they are. Possible contaminants include heavy metals, such as lead and chromium; explosive residues (e.g. TNT, DNT); and herbicides.

4.4.4.1 Proposed Action

Approximately two (2) water and two (2) sediment samples should be collected from each end of the pond and analyzed for the presence of heavy metals, explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose, and nitroguanidine), and herbicides.

4.4.5 Asphalt Lined Test Pond - JPG-020

This pond is approximately 1/2-acre in size and is lined with asphalt and gravel. The pond was drained and no munitions-related materials were found. While no shells were present on the asphalt bottom, it is not known if any EO lies beneath the pond; shells may have penetrated the asphalt, or may have been there prior to construction of the pond. As such, explosives residues may be in the soils and ground water.

4.4.5.1 Proposed Action

One soil sample should be collected from the drain in the corner of the pond. In addition, approximately, two (2) soil samples should be collected from beneath the asphalt liner and around the pond and analyzed for heavy metals (As, Ba, Cd, Cr, Pb and Hg), explosive residues such as TNT, DNT, RDX, HMX, HMS, tetryl, nitrocellulose and nitroguanidine and herbicides. Any surface waters nearby should also be sampled and analyzed for the same

parameters. If significant contamination of soils and surface water is found, ground water monitoring wells should be installed to determine the impact that these chemicals have had on ground water.

4.4.6 Abandoned Well/Cistern Disposal Site - JPG-021

This site, located at the intersection of "I" and Cottrell roads, is reportedly an abandoned cistern used for the disposal of fuses. A review of previous studies indicated that while this site is a potentially hazardous waste disposal site, it is unidentifiable. The U.S. Army Environmental Hygiene Agency (AEHA) Ground Water Contamination Survey - Evaluation of Solid Waste Management Units, August 1988, indicated that the status of JPG-021 was that it was no longer visible and/or has been cleaned up. The location of the cistern could not be identified during the site visit performed as part of the Enhanced Preliminary Assessment. It is not known if the fuses were removed from the cistern, so this site may still contain potentially hazardous materials. Over time, metals such as lead and chromium, and explosive chemicals (i.e. TNT and DNT) may enter ground water and soils.

4.4.6.1 Proposed Action

This cistern/well must be located to assess the potential for a release to the environment. Water from the cistern/well and the

soil surrounding it should be sampled and analyzed for heavy metals, and explosive residues such as TNT, DNT, RDX, HMX, HMS, tetryl, nitrocellulose and nitroguanidine. A GC scan may be used to screen for the specific compounds and to perform detailed analysis only on those that are detected and identified. If significant contamination is found in the water in the cistern and the soils surrounding it, a ground water monitoring system should be installed. Approximately four (4) wells should be installed to characterize both upgradient and downgradient water quality.

4.4.7 Explosives Burning Ground - JPG-022

This is a thermal treatment area which is no longer utilized, located just south of the 16000 East impact area. The area was used for the open burning of powdered explosives. Black residue is present in some areas of the ground surface, but there is no trace of open burning on the ground in the southwest corner of 16000E.

4.4.7.1 Proposed Action

To assess the impact that burning of explosives has had in this area, approximately ten (10) sub-surface soil samples should be collected at depths of 0-2 ft and 2-5 ft at 5 locations. These samples should be analyzed for the presence of explosive residues such as TNT, DNT, RDX, HMX, HMS, tetryl, nitrocellulose and

nitroguanidine and herbicides. These soil samples should be taken in the immediate area where the explosives were burned as well as in the area surrounding the actual burning ground. In addition, the samples should be analyzed for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

One sample of surface water and one sample of sediments down slope, as well as water standing in puddles in the burn area should be sampled (approximately three samples) and analyzed for the same parameters.

A ground water monitoring system, consisting of at least one up gradient and three down gradient wells, should be installed if explosive residues or heavy metals are identified in the soil and water samples. Ground water should be collected and analyzed for the same parameters as above. Because this area must be considered to be heavily contaminated with EO, very strict well installation procedures must be used. Ground water monitoring wells should be installed so they screen the first aquifer, and/or the unconsolidated material just above bedrock.

4.4.8 Open Detonation Area - JPG-023

This is a 12.5-acre thermal treatment unit located at Shonk Farm, which is just south of the bomb field. The site operates under RCRA Interim Status for open burning and above ground detonation.

The area is an open field with an open burning cage approximately 5 feet x 25 feet x 6 feet, with 1-inch heavy steel mesh. Open detonation operations occur approximately 10 times per year. JPG uses the open burning cage to dispose of spent or unusable fuses, detonators, primers, and grenades. Debris on the ground consists of inert projectiles and metal fragments. Residual waste products consist of ash, fused or unfused ammunition and scrap metal casings and fragments. Propellants from the above devices and a small amount of actual explosive are also present. The migration and dispersal characteristics of these materials vary with soil conditions and the solubility of the waste material. Ground water is expected to be approximately 10 to 25 feet below land surface in this area, and is the migration pathway of concern at this site.

4.4.8.1 Proposed Action

Because this is a RCRA permitted site, closure requirements must comply with the accepted closure plan. It is recommended that a geophysical survey using equipment such as ground penetrating radar or a resistivity or conductivity meter be conducted to locate any EO that may exist in the area, as this site is located immediately south of the bombing/strafing range. After it is deemed safe to do so by JPG EOD personnel, soil samples should be collected at depths of 0-2 ft and 2-5 ft from the ground surface at approximately five (5) locations. Representative samples should be submitted for laboratory analysis. These samples should be

collected and analyzed for explosive residues such as TNT, DNT, RDX, HMS, HNS, Teteryl, nitrocellulose, nitroguanidine, herbicides and TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

The open detonation/open burning area is on top of a hill; seeps on the slope toward Big Graham Creek should be sampled and analyzed for the same parameters as the soil samples. If these seeps are contaminated, a ground water monitoring system, consisting of approximately ten (10) monitoring wells should be installed. These wells should be screened just above bedrock or a confining clay layer. Water from the wells should be analyzed for the same parameters as the soil samples.

4.4.9 Landfill - JPG-024

JPG-024 is a 1-acre abandoned landfill of unknown depth. The landfill was used until the early 1980s for disposal of solid wastes from the Old Timbers Lodge. Waste from the lodge included putrescibles, paper, and other non-toxic household-type wastes. It has also been claimed that ammunition, extra primers, and other ordnance related materials were disposed of at this site. This may be a reasonable assumption, because there is a gun position/target at the end of the access road. Ground water is a potential pathway for migration.

4.4.9.1 Proposed Action

To determine the impact that waste disposal at this site has had on the environment, the limits of this landfill must be properly defined. It is proposed that both the areal and vertical extent of the landfill be defined by geophysical methods: surface resistivity, ground probing radar, and magnetometry. Once this is done, soil sampling and installation of ground water monitoring wells can be accomplished. Approximately four (4) borings per acre should be installed. Soils should be sampled at 0-2 ft and 2-5 ft intervals and analyzed explosive residues such as TNT, DNT, RDX, HDX, HmS tetryl, nitrocellulose, nitroguanidine and TCLP metals (Ag, As, Ba, Cd, Cr, Pb and Hg). If soils are determined to be contaminated, a groundwater investigation would be required.

Because the areal extent of the landfill is unknown, it is not possible, at this time, to properly design a ground water monitoring network. Approximately four (4) wells should be installed to characterize both the upgradient and downgradient water quality. The wells should monitor the unconsolidated materials immediately above bedrock and/or the first saturated zone in the unconsolidated deposits. Water from these wells should be analyzed for the same parameters as the soil samples.

4.4.10 Landfill - JPG-025

This landfill, approximately 1-acre in size, is located adjacent to JPG-024. The landfill was used for approximately 2 years for the disposal of solid wastes and construction-type debris by campers and construction workers. The landfill is no longer utilized and is overgrown with tall weeds and grasses and seedling trees. Reportedly, the wastes buried at this site were neither hazardous or toxic, however, like JPG-024, ammunition, fuses, and other ordnance may have been disposed here.

4.4.10.1 Proposed Action

To determine the impact that waste disposal at this site has had on the environment, the limits of this landfill must be properly defined. It is proposed that both the areal and vertical extent of the landfill be defined by geophysical methods: surface resistivity, ground penetrating radar, and magnetometry. Once this is done, soil sampling and installation of ground water monitoring wells can be accomplished. Soils should be sampled at 0-2 ft and 2-5 ft intervals from approximately four borings and analyzed for TCLP metals (Ag, As, Ba, Cd, Cr, Pb and Hg) and explosive residues such as TNT, DNT, RDX, HMX HNS, tetryl, nitrocellulose, nitroguanidine. If the soil is determined to be contaminated, a groundwater investigation would be required. These soil borings may

be required to be extended deeper or additional borings may have to be drilled upon the results of the initial investigation.

Because the areal extent of the landfill is unknown, it is not possible, at this time, to properly design a ground water monitoring network. Approximately four (4) wells should be installed to characterize both upgradient and downgradient water quality. The wells should monitor the unconsolidated materials immediately above bedrock and/or the first saturated zone in the unconsolidated deposits. Water from these wells should be sampled and analyzed the same parameters as the soil.

Because this landfill may be located immediately adjacent to JPG-024, it may be cost effective to treat these sites as one. If it is technically possible (and correct) it is recommended that this be done.

4.4.11 Landfill - JPG-026

This is a 1-acre, abandoned landfill of unknown extent. It is reportedly located at the foot of Little Otter Dam, but may be located elsewhere in this general area. For example, Figure 2.3, the facilities map, shows the location of a landfill just east of the lake. It is not known if this is an additional landfill or if the location was not properly determined.

The landfill was used for approximately 2 years for the disposal of solid waste and construction debris by campers and construction workers. The landfill is no longer utilized, and cannot be discerned.

Reportedly, the wastes buried at this site were neither hazardous nor toxic. Ground water is expected to be shallow in this area, and the landfill is located near Little Otter Fork. Thus, there is potential for migration of contaminants. There is minimal potential for exposure as long as the area remains undisturbed.

4.4.11.1 Proposed Action

Even though this landfill was reportedly used only for the disposal of solid wastes from the construction of the lake, the limits of the landfill must be delineated in order to determine if the wastes pose a potential threat to the environment. In order to make this determination both the areal and vertical extent of the landfill should be defined by geophysical methods: surface resistivity, ground probing radar, and magnetometry. Once this is done, soil sampling and installation of ground water monitoring wells can be accomplished. Approximately four (4) soil borings should be drilled and the soils should be sampled at 0-2 ft and 2-5 ft intervals. These samples should be analyzed for TCLP metals (As, Ba, Cd, Cr, Pb and Hg). The soil borings may be required to be extended deeper or additional borings may have to be drilled

depending upon the results of the initial investigation. If the soil is determined to be contaminated, a groundwater investigation may be required.

Because the areal extent of the landfill is unknown, it is not possible, at this time, to properly design a ground water monitoring network. Approximately four (4) wells, one up gradient and three down gradient, should be installed to characterize groundwater quality. The wells should monitor the unconsolidated materials immediately above bedrock and/or the first saturated zone in the unconsolidated deposits. Water from these wells should be sampled and analyzed for the same parameters as the soil samples.

Because this waste disposal site may be located adjacent to Little Otter Creek, surface water downstream from the landfill should be sampled and analyzed for indicator parameters.

4.4.12 EO Contamination North of the Firing Line

Land north of the firing line consists of approximately 50,000 acres (Figure 4.16). Parts of this area, approximately 8,600 acres have been used as designated impact or target areas for test-fired ordnance. These represent the primary areas known to be heavily contaminated with EO. JPG staff estimate that approximately 23 million rounds have been fired since 1941. JPG personnel estimate that approximately 1.4 million rounds did not explode. An

1954 AND 1987
BOMBING RANGE AREA

MINEFIELD

DEPLETED URANIUM
IMPACT FIELD

LEGEND

Impact Areas

5,000 0 5,000 10,000
SCALE IN FEET

MASTER ENVIRONMENTAL PLAN
JEFFERSON PROVING GROUND
MADISON, INDIANA

EBASCO ENVIRONMENTAL

FIGURE 4.16
Location of Impact Field

important fact for consideration about the area north of the firing line is that most of the areas between the actual targets have been contaminated with EO. The reason for this is that the actual target areas are used only when the detonation and/or impact of the projectile is important to the test. Many of the tests are used only for velocity measurements, gun tube proofing, propellant tests, etc., and impact points are unimportant. Also, the test rounds may have fallen short, flown long, drifted east or west, or skipped or ricocheted when they hit the ground. There is limited information available relative to the location or distribution of the test rounds. It must be assumed that unexploded ordnance is not confined to the identifiable, designated impact areas; it could be present everywhere down-range.

Potential contaminants in these areas include metals, propellants, and explosives from mines, ammunition, cartridge cases, artillery projectiles, mortar rounds, grenades, tank ammunition, bombs, boosters, and rockets. A significant physical hazard is created by the presence of the EO at and beyond the impact fields. The presence of unexploded ordnance represents both the hazard of detonation if disturbed, and chemical hazards associated with high explosive, propellant, white phosphorus and metals from cracked and leaking shell cases. The toxicity of EO components is of environmental concern, but the migration of these materials is of relatively less concern than their potential to detonate or ignite.

4.4.12.1 Proposed Action

An extensive review of all available ordnance detection and removal technology along with their associated costs should be undertaken to determine the options available prior to undertaking any clearance activities. A concerted effort should be made to identify the locations of all EO north of the firing line. Not only would this action identify EO for proper disposal, it will also allow for the determination of relative densities of EO at JPG. Knowing locations and relative densities will allow for the prioritization of clean-up areas.

The methods involved in this program would include cutting and/or burning of vegetation, followed by geophysical surveys using equipment such as ground penetrating radar or conductivity or resistivity meters to locate EO that was on the surface. Following a thorough review of available technologies, six representative areas (approximately 1 acre each in size) requiring environmental evaluation should be selected. The EOs in these designated areas should be cleared and detonated according to US Army protocol. Surface and sub-surface soil samples should be collected and analyzed for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. In addition, the soil samples should also be analyzed for TCLP metals (As, Ba, Cd, Cr, Pb and Hg) and herbicides. If the soil is determined to be contaminated, a groundwater investigation may be necessary.

4.4.13 Depleted Uranium Contaminated Area

More than 60,000 kg of low-level radioactive depleted uranium penetrators were fired on a 2-square mile area. The firing of this type of round has cleared a narrow strip of land, which was already contaminated with EO. DU rounds are fired against a canvas target. Therefore, the rounds do not burn or aerosolize. Depleted uranium is used because it has an exceptionally high specific gravity, which allows it to penetrate steel armor. The majority of DU rounds remain intact upon firing, though some do break into large pieces on impact. DU rounds are nonexplosive projectiles comprised of a DU body, a nose cone, and fins to stabilize the round in flight. The penetrators tend to skip and ricochet when they impact the ground because they have a large amount of momentum (large mass x high velocity). This allows them to travel a considerable distance downrange, even after impact.

An estimated 20 percent (12,000 kg) has been recovered in the limited cleanup efforts conducted twice each year. The low level of radioactivity from the depleted uranium is readily detected and does not present the imminent threat that unexploded general ordnance items do. However, DU does represent a toxicological hazard as a metal. Potential release mechanisms include the migration of radioactive contaminants through soils to ground water. The DU penetrators oxidize in air forming uranium oxides

that can flake off the penetrators, and remain in the soil after the penetrators are removed. Sampling in the affected area occurs approximately every six (6) months. Soil, sediment, and ground water samples (collected from existing monitoring wells) are collected and analyzed for radioactivity. Analysis performed thus far indicates that while the DU rounds represent a low-level radioactive hazard, radioactive materials have not migrated through soils to ground water.

4.4.13.1 Proposed Action

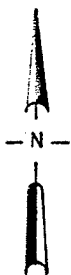
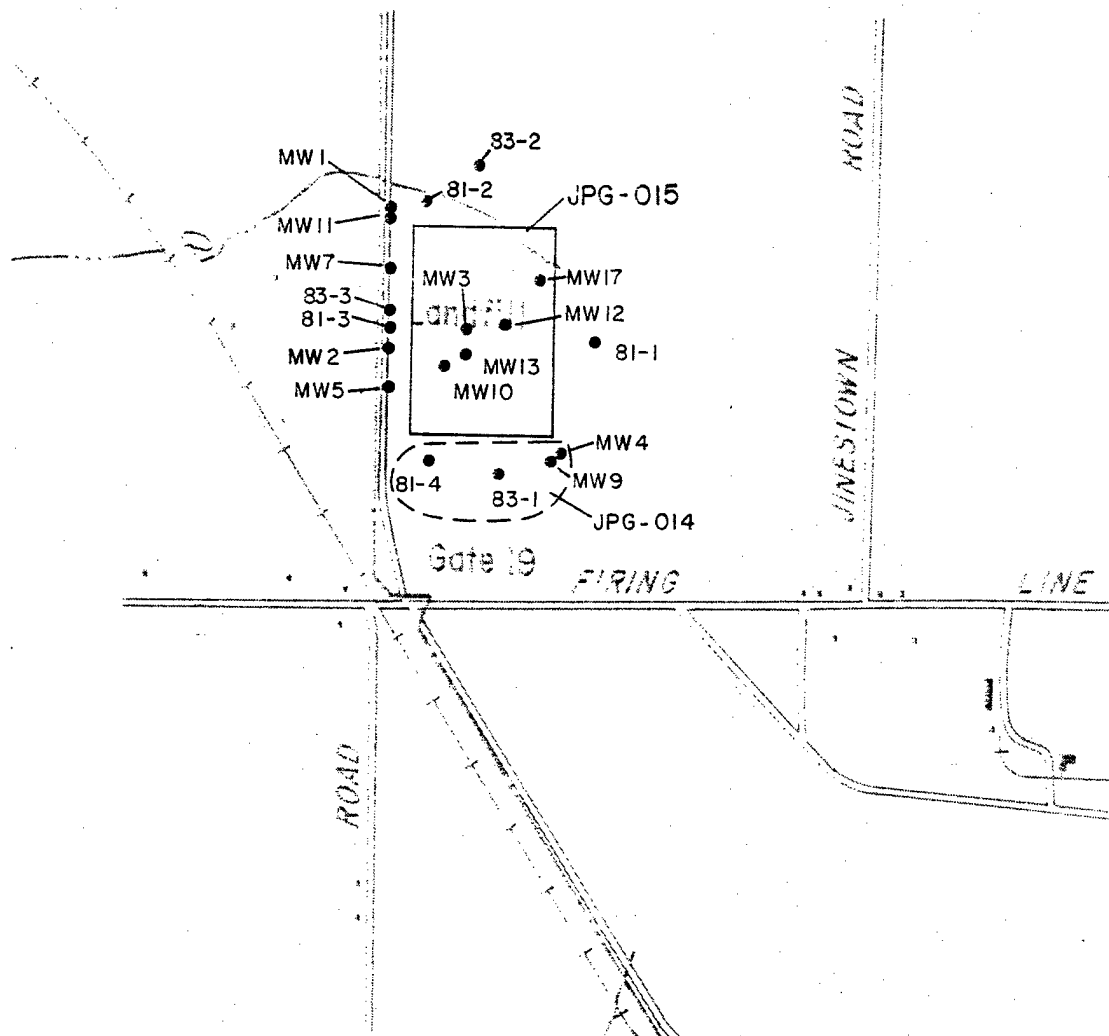
The monitoring program already in place at JPG for the DU area be continued. It is also recommended that additional ground water monitoring wells should be installed around the immediate area of the DU impact area, to ensure adequate coverage. Existing monitoring wells installed near the perimeter of this area nearby are not adequate. Approximately twelve (12) additional wells should be installed around the perimeter of the DU impact area and incorporated into the DU monitoring program.

4.5 GATE 19 AREA

The Gate 19 landfill and a burning ground just south of the landfill are located in the Gate 19 Area. Specific information regarding the geology and hydrogeology in the area has been

obtained through the installation of boreholes and ground water monitoring wells around the landfill.

In 1988, fourteen (14) ground water monitoring wells were installed under a remedial investigation to characterize the Gate 19 landfill (Figure 4.17). Analysis for VOCs (related to reported receipt of TCE) and EP Toxicity lead was performed during two separate sampling events. During ground water sampling conducted in July 1988, bis (2-ethylhexyl) phthalate was detected in ground water samples collected in wells monitoring the Gate 19 landfill. This compound is a plasticizer, and may be attributed to plastics in the Gate 19 landfill, PVC well casings and bailers, and/or laboratory contamination of the sample itself. All bis (2-ethylhexyl) phthalate concentrations were below detection limits, however, in all of the wells sampled in October 1988. Acetone (27 ug/l) was detected in MW5 during the October 1988 sampling event. In the monitoring wells installed in 1988, massive limestone bedrock was encountered between eight and fourteen feet below the land surface (bls). The unconsolidated deposits overlying bedrock were comprised of grey and brown silty clays and clays. Most of these wells were completed to a depth of fifty-five feet, because this is approximately the depth at which ground water was encountered. All wells were completed in limestone. Hydrogeological analysis indicates that the ground water in this area moves toward the west-northwest at a velocity of approximately 15 feet per year (Figure 4.18).

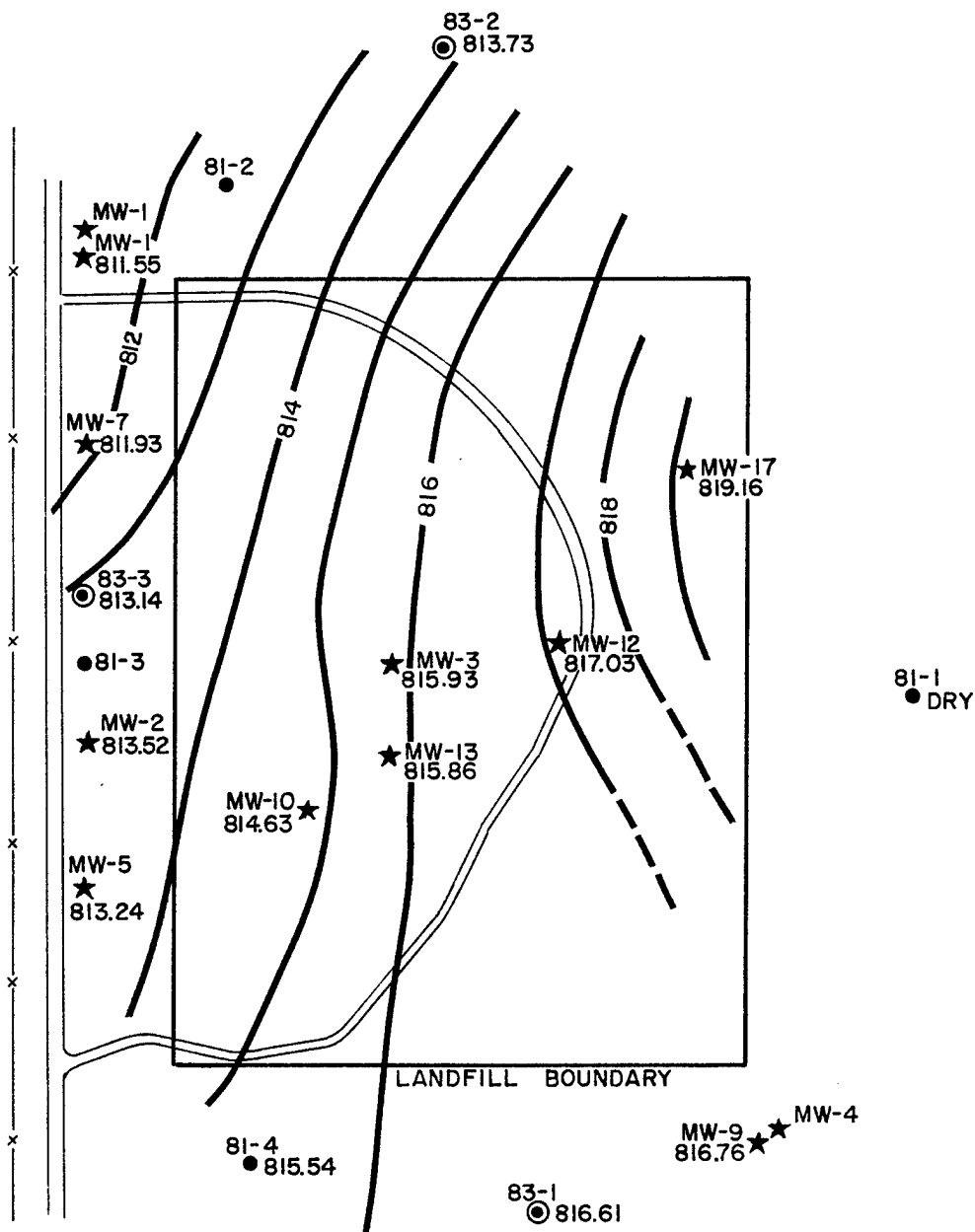


500 0 500 1000
SCALE IN FEET

MASTER ENVIRONMENTAL PLAN
JEFFERSON PROVING GROUND
MADISON, INDIANA

EBASCO ENVIRONMENTAL

FIGURE 4.17
JPG-014, 015



KEY

- GRAVEL ROAD
- MONITOR WELL (81 SERIES)
- ⊙ MONITOR WELL (83 SERIES)
- ★ MONITOR WELL (ESE INSTALLED)
- GROUNDWATER CONTOUR
- 815.50 WATER ELEVATION

SCALE

75 0 75 150 FEET

25 0 25 50 METERS

N

SOURCES: JPG, 1981; ESE, 1989.

MASTER ENVIRONMENTAL PLAN
JEFFERSON PROVING GROUND
MADISON, INDIANA

EBASCO ENVIRONMENTAL

FIGURE 4.18
Groundwater Contour Map
10/17-19/88 Gate 19 Landfill

4.5.1 Burning Ground - JPG-014

JPG-014 is a 1/2 acre thermal treatment area once used for the open burning of construction debris and waste POL. It is located immediately south of the Gate 19 landfill. Evidence of open burning at this area was not seen during the site visit. Historical records of this area are vague, but aerial photographs from the 1950s to the 1970s show liquid-filled trenches and mounded material in this area. In the 1960's and 1970's, this site (and the adjacent Gate 19 landfill) reportedly received trichloroethane (TCE) and paint. Though this area is no longer used for burning of any type of material, the reports of TCE and paint dumping indicate that a release to the environment probably occurred in this area.

The present contaminant release mechanism is migration of contaminants through soils into ground water. The potential for ground water contamination is strong, for TCE is a highly mobile solvent. The metals in waste paints and residual ash from burning may also be mobile. Ground water in this area is approximately 25 feet below the surface. Ground water flow direction is generally from the southeast to northwest, which could result in the migration of contaminated ground water outside the installation boundary, potentially contaminating private drinking water wells in the surrounding area. Ground water flow directions may vary

locally due to the influence of the water filled limestone quarry located adjacent to this area.

While analytical results from the remedial investigation indicate that little if any ground water contamination may be present in the vicinity of the burning ground, contamination could still exist. The down gradient monitoring wells, located along the West Perimeter Road, are intended to detect any contaminant plume originating from the burning ground that might migrate off-post. To date, no such plume has been detected.

4.5.1.1 Proposed Action

Geophysical surveys using ground penetrating radar or conductivity or resistivity meters should be conducted in this area to determine the extent and limits (both areal and vertical) of this waste disposal site. Soil samples should be collected at approximately ten (10) locations in the delineated area; these soils should be collected from the ground surface to below the depth of the trenches that were reportedly used for the burning of liquids. The soil samples should be analyzed for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

If the soil is determined to be contaminated, a groundwater investigation may be necessary. This is addressed as part of the proposed actions for the Gate 19 landfill (see Section 4.5.2.1).

4.5.2 Gate 19 Landfill - JPG-015

This solid waste management unit is an active 12-acre landfill, including an asbestos disposal area and waste pile (construction debris), of unknown depth. The landfill has been in use from the 1960's to the present. Disposal of construction debris and asbestos are in separate areas within the landfill. Additionally, this landfill was reportedly used for dumping of lead oxide, paint and methylene chloride/polyurethane residues.

Construction debris mainly consists of concrete block, metal, wire, asphalt, and a minor amount of wood, which is deposited on the ground in the construction debris section of the landfill. This portion comprises as much as 10 acres of the total area. The construction debris disposed at the Gate 19 landfill is inert and has minimal potential to migrate. This area also contains ash from the incinerator and from the open burning of propellants.

The asbestos portion of the landfill is a shallow area where double-bagged asbestos is buried.

Between 1960 and 1980, the landfill reportedly received 3000 to 5,000 gallons of trichloroethane, paint sludge and thinners. The reports of TCE and paint dumping suggests that a release to the environment occurred at this area. TCE can migrate into ground water under conditions of moderate to high permeability. The

metals in waste paints are not as mobile, and bond to organic material in soils unless the conditions are acidic. The potential contaminant release mechanism is the migration of contaminants through soils into ground water. Ground water in this area is approximately 25 feet below the surface. The ground water flow direction is generally from the east to west, which could result in the migration of contaminated ground water from the installation, potentially contaminating private drinking water wells in the area.

While the analytical results from the Remedial Investigation, indicate that ground water contamination in the vicinity of the Gate 19 landfill may not exist, there is a possibility that contaminated groundwater may be present. The down gradient monitoring wells, located along the installations' western perimeter, are intended to detect any contaminant plume originating from the Gate 19 landfill that might potentially migrate off-post. No such plume has been detected, but the wells installed at the landfill may not be adequate to properly define ground water quality, for several of them are dry, and do not produce samples for laboratory analysis. Also, because all the wells were installed at depths up to 101 feet in massive and relatively impermeable bedrock, detection of contaminants may not always be possible. Chlorinated solvents will typically move down through the unconsolidated deposits until a layer of relatively impermeable material is met; the solvent will then move laterally along that interface. In this case, the solvents are expected to migrate

downward until the limestone is encountered, and then move laterally according to the local flow gradient. This flow gradient may be controlled by the top of the bedrock topography in unsaturated areas, groundwater flow gradient in saturated areas, or by other geologic/hydrogeologic features.

4.5.2.1 Proposed Action

The placement and installation of the current network of ground water monitoring wells should be reviewed for adequacy in determining if off-site migration has occurred or if the existing system could detect the potential for such migration. Based on this review, additional wells should be installed as appropriate at the unconsolidated/consolidated material contact, and/or into shallow bedrock. The rationale behind this comes from headspace analysis for MW2, where the TIP-I photoionization detector readings read from 67 ppm in the 0 to 2' bls sample to 300 ppm in the 10-12' sample to saturated (>999 ppm) in the 14-14.5' sample; bedrock was encountered at 14' bls. Water collected from these wells should be analyzed for TCL parameters. Existing wells should also be resampled. All wells located at this site should be incorporated into a comprehensive ground water monitoring program. These wells should be sampled quarterly (to cover all seasons in a year) for at least two years. After two years, the sampling and analysis program should be re-evaluated, with the frequency of sampling/analysis and analyte list being readjusted accordingly.

4.6 OTHER AREAS REQUIRING ENVIRONMENTAL EVALUATION

Some areas of environmental concern were identified during Ebasco's Enhanced PA site visit conducted in November 1989. The specific concerns include PCB-containing oils, asbestos, underground storage tanks, surface water, ground water, radon gas, and lead paint. Locations where these concerns are applicable are not and should not necessarily be considered SWMUs. However, the potential for releases to the environment, resulting contamination, and potential toxicity must be addressed to completely characterize the areas requiring environmental evaluation.

4.6.1 PCB Containing Oil

In January 1989, an inventory of all transformers (252) was conducted as part of a quarterly internal inspection. The inspection did not indicate whether a release of PCB-contaminated liquids had occurred, although the conditions of all containers were defined as "good." It is unknown whether these transformers have ever leaked fluid. The potential PCB-contaminant release mechanism is the leaking of PCB containing oils from transformers onto shallow soils. If a release to the environment has occurred, investigation through the performance of sampling and analysis of the affected environmental media is necessary.

Each of the transformers was sampled at the time of the inventory, and analysis indicated that seven (7) of the transformers contained levels of PCBs greater than 500 ppm.

4.6.1.1 Proposed Action

The current PCB management program at JPG should continue.

4.6.2 Asbestos Containing Materials

Asbestos presents the most significant hazard when it is friable (easy to crumble), because it can be easily respired. Asbestos becomes friable as it degenerates on construction materials and during removal and abatement activities. The abatement of hazards from asbestos containing materials usually consists of removal or encapsulation. Asbestos containing materials are present in several of the JPG buildings. These construction materials include, but are not limited to, pipe insulation, roof shingles, and siding. A preliminary survey estimated that the total length of pipe insulated with asbestos is approximately 197,000 linear feet. Asbestos shingles and siding account for an additional 258,000 square feet (approximately). Currently, JPG uses the Gate 19 landfill (JPG-015) as a permitted disposal site for double-bagged asbestos materials.

The asbestos materials encountered during the enhanced preliminary assessment site visit were indicative of a significant amount of friable asbestos. The parties present during the site visit at the airport hangar observed asbestos containing lagging hanging from pipe insulation runs, and pipe runs where exposure to the natural elements of wind, heat, or water continue to create a human health hazard. The asbestos was subsequently removed from the installation.

4.6.2.1 Proposed Action

In order to assess the existing conditions of asbestos containing materials at Jefferson Proving Ground, it is recommended that the asbestos survey that was conducted be reviewed for adequacy, and a new survey be initiated if necessary.

Also, JPG should continue to undertake remedial measures to prevent the release of any asbestos containing material which constitutes a human health hazard. JPG should continue its current asbestos management procedures for removal and handling of asbestos containing materials. Base Closure would require the complete remediation of all asbestos which presents an airborne human health hazard.

4.6.3 Underground Storage Tanks

Currently, there are 54 underground storage tanks (USTs) located at various sites at JPG. The tanks were installed between 1941 and 1985, with capacities ranging from 300 to 25,000 gallons. The tanks are constructed of materials ranging from bare steel to coated steel. The exact locations of all of the USTs are known. The contents of the USTs include No. 2 fuel oil, diesel oil, leaded and unleaded gasoline and kerosene, and white gas. Due to the age of the majority of the USTs, some of tank contents may have leaked into the surrounding soils, and possible the groundwater. Appendix III shows the analytical results from some of the soil samples collected from around the areas where USTs were removed. These samples were collected from the bottom and the side walls of the holes. The concentration of petroleum contaminants vary from 137 to 4,378 mg/kg.

4.6.3.1 Proposed Action

JPG should undertake a program of tank testing or removal to ensure that all the USTs are in compliance with Federal, State, and local regulations. Because of the high levels of petroleum contamination associated with the soils in the areas where USTs were removed, a remedial investigation should be undertaken in those areas to determine the extent of contamination, and to identify appropriate disposal/treatment options.

4.6.4 Surface Water

Seven creeks traverse Jefferson Proving Ground. The creeks include Otter Creek, Graham Creek, Little Graham Creek, Marble Creek, Big Creek, Middle Fork Creek and Harberts Creek. The potential for contaminant release to surface waters is not well defined.

The nature and quality of the surface water both upstream and downstream from JPG is unknown; streams flowing onto JPG have the potential to carry agricultural contaminants (fertilizers and pesticides) from nearby farms onto JPG. Streams that cross JPG may carry contaminants (such as explosives, explosives residues, metals and herbicides) downstream, and therefore, off site. Water and sediments from both upstream and downstream have not been sampled and analyzed for the above named analytes.

4.6.4.1 Proposed Action

It is recommended that water and sediments from surface water bodies located on JPG be collected and analyzed for the presence of explosives residues (specified in previous sections), heavy metals, fertilizers and pesticides and herbicides. These samples should be collected wherever a stream flows onto or off of Jefferson Proving Ground (approximately 17 locations). Additionally, each lake and pond on site (approximately 10) should

be sampled. Streams that cross target areas should be sampled, both upstream and downstream of the target areas, to define the impact that the targets have on surface water quality. Sampling of surface waters and sediments should be conducted quarterly for two years. Based on findings from the two year study, sampling frequency should then be re-evaluated.

4.6.5 Ground Water

The shallow bedrock in the JPG area does not produce a large amount of ground water. Public/private utilities provide water service to most of the households in the small rural areas surrounding JPG, but a number of private wells are located in the surrounding areas. The private wells could be considered as potential off-site receptors if contaminants are migrating via ground water from JPG. Potential contaminants of concern include metals, explosives and propellants from EO, fuel/petroleum products from USTs, solvents and leachate from landfills and disposal pits, and possibly pesticides. The regional flow appears to be in the south-southwest direction, but many surface and bedrock features could alter the flow direction. Currently, there are no ground water monitoring wells located along the perimeter of the JPG property, except in the Gate 19 landfill area.

Ebasco contacted the Indiana Department of Natural Resources, Division of Water and determined that reliable information is not

currently available on residential wells within a two mile radius of JPG. The Division of Water informed Ebasco that an accurate determination of the number of residential wells can be made only by contacting the residents in the immediate vicinity and conducting a survey.

4.6.5.1 Proposed Action

A review of well users within a two mile radius from the perimeter of the installation should be undertaken. This information would be required to determine whether off-site migration of contaminants will pose a significant threat to the surrounding community.

A limited perimeter ground water monitoring system may be necessary for JPG. Data from investigations within the interior of JPG should be reviewed so that the number and location of perimeter wells may be determined. The installation of a perimeter system will allow for the proper characterization of the quality of ground water that flows onto and off of JPG. The perimeter well program should include wells that are close to the source. In this way, the impact of past and present activities at JPG on ground water can be assessed.

The ground water monitoring wells at JPG should be installed in phases, so that the ground water flow directions and ground water quality can be assessed in a cost effective manner.

The entire monitoring system installed at JPG should include wells that must be installed around SWMUs, AREEs, and impact areas. This should be done as part of a comprehensive program, so that the number of ground water monitoring wells needed may be minimized.

All drilling, sampling and well installation activities, as well as siting surveys, must be done under the direct supervision of the EOD personnel at JPG. All general surveying and intrusive activities at JPG are potentially dangerous, and may be lethal, due to the explosive hazards present.

4.6.6 Radon Gas

Radon gas is generated by the decay of uranium in the bedrock and/or other subsurface features (such as glacial till) prevalent in Indiana. Radon gas migrates toward the surface through subsurface joints, pores, and fissures, and enters structures through building foundations (most commonly detected in basements and first floor areas). The potential release mechanism for the gas is via air transport. Radon gas can potentially exist in any of the buildings at Jefferson Proving Ground. To date a 7-day, 90 day and 12 month radon gas surveys have been completed at all of the JPG family quarters, building 112 basement and tunnel shelter areas. This building (#112) is the only building with a basement on the facility. The results presented in Appendix IV show that the

background radon levels are less than the EPA's Safe level of 4 pico Curie/liter. The 90 day testing was done during cold weather.

4.6.6.1 Proposed Action

No Recommended Action

4.6.7 Lead Paint

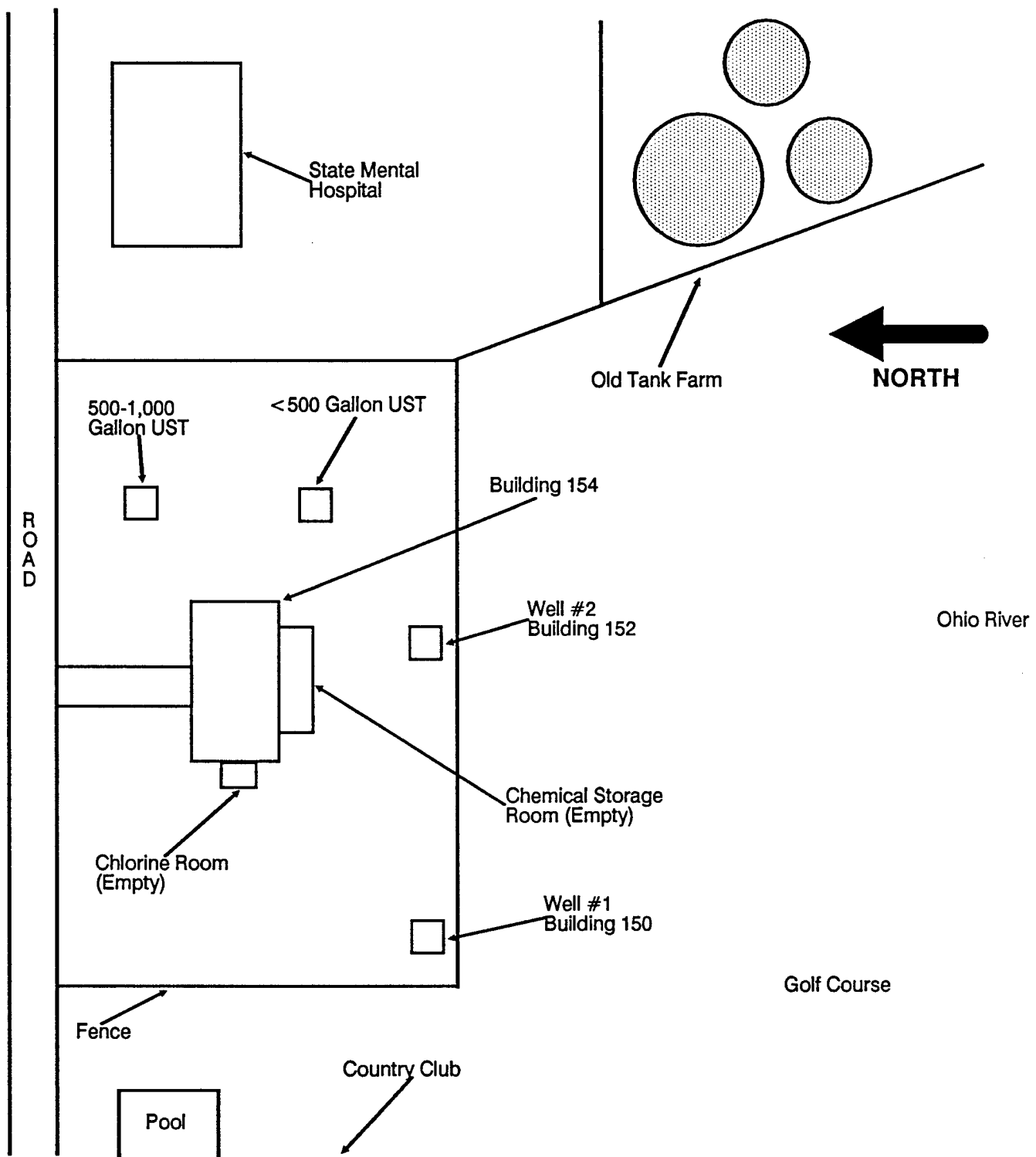
Several of the buildings at JPG were reportedly painted with lead paint. Lead is hazardous to human health in small quantities when inhaled or ingested. To date, no lead paint surveys have been conducted at any of the JPG facilities.

4.6.7.1 Proposed Action

Lead paint surveys should be conducted in all residential buildings located at JPG.

4.6.8 Water Supply Wells

The two drinking water wells (Well #1 and 2) are located downtown near the Madison Country Club. The Ohio River is located approximately 200-300 feet south of the wells. The wells were taken out of service in 1984. Figure 4-19 shows the approximate locations of the wells with respect to the surrounding areas. One



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JEFFERSON PROVING GROUND
MADISON, INDIANA

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FIGURE 4-19
Sketch of JPG Wellfield Layout

500 gallon UST containing diesel fuel and another 1000 gallon UST containing water and diesel fuel are located on the property, north-east of these wells. These tanks are scheduled to be emptied and properly closed in 1990.

South-east of these wells is located a privately owned tank farm (not situated on JPG property). Many of the tanks contained petroleum products such as gasoline and diesel which reportedly leaked. If the JPG wells (#1 and 2) are restored for unrestricted use, flow of water could be induced from the vicinity of the tank farm since this is located within the radius of influence of the two wells. Potential contaminants could thus be transported to the well waters.

The pumps for the two wells are located in Buildings #50 and 152. The oil from the motors of these pumps drips continuously onto the base plate and could possibly have leaked into the well casings. The paint from the basement of these pump houses is peeling off and could contain lead.

The control room for the pumps is located in Building 154. This room used to house a generator. The exhaust from the generator is vented outside through an insulated pipe. The insulation does not appear to be in good condition and could contain asbestos.

4.6.8.1 Proposed Action

Proceed with the efforts to properly close the two USTs on JPG property. Approximately two water samples should be collected (one from each well) and analyzed for primary and secondary drinking water parameters. This would determine if the wells can still be used. The paint peeling off the basement walls of Buildings 150 and 152 should be sampled and analyzed for lead. The insulation material from the exhaust pipe in Building 154 should be sampled and analyzed for asbestos.

5.0 SUMMARY OF PROPOSED ACTIONS

This section presents, in brief form, a summary of proposed action for each of the solid waste management units and other areas requiring environmental evaluation. The section is set by geographical area up like Section 4.0. A summary table follows in Section 5.7.

5.1 PROPOSED ACTIONS SOUTH OF THE FIRING LINE (WEST SIDE)

- Building 185 (Old Incinerator) - (JPG-001)
 - o Collect two scrape samples of incinerator residues; analyzed for TCLP Metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se).
 - o Collect four soil samples, from 0 to 6" bls, one on each side of the building, analyzed for TCLP Metals (Ag, As, Ba, Cd, Cr, Hg and Se).
- Building 177 (Water Quality Laboratory) - JPG-002
 - o No recommended action.
- Building 177 (Sewage Treatment Plant) - JPG-003

- o Collect approximately 10 soil samples from around the building, trickling filters and sludge drying beds; analyze for total concentration of silver, TCLP silver and cyanides. If the total concentration of silver is below the regulated limit (5 mg/L) in the TCLP extract, TCLP analyses is not necessary.
- Explosives Burning Area - JPG-004
 - o Conduct a geophysical survey using ground penetrating radar or a conductivity meter or resistivity meter or magnetometer to locate extent of burning area.
 - o Collect approximately 20 soil samples at the ground surface and below the trench bottoms; analyze for explosive residues such as TNT, DNT, RDX, HMX, HNS, nitrocellulose, nitroguanidine and teteryl. A GC scan should be used to screen the samples and only those compounds which are identified in the scan analyzed in detail and quantified. Also analyze for TCLP metals (Ag, As, Cd, Cr, Pb and Hg).
 - o If soil samples are determined to be contaminated, a groundwater investigation should be considered.

- Landfill - JPG-005

- o Conduct a geophysical survey using ground penetrating radar or a conductivity meter or resistivity meter to determine the vertical and horizontal extent of the landfill.
- o Collect approximately 8 soil samples, at four boreholes; analyze for Target Compound List (TCL) parameters.
- o Approximately four monitoring wells should be installed to characterize both upgradient and downgradient groundwater quality. These wells should be sampled and analyzed for the same parameters as the soil samples.

- Wood Storage Pile - JPG-007

- o No recommended action.

- Contaminated Wood Storage Pile - JPG-008

- o No recommended action.

- Building 33 (New Incinerator) - JPG-011
 - o Collect scrape samples of interior surfaces of incinerator stack; analyze for TCLP metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se).
 - o Collect approximately four soil samples, one on each side of the building, from 0 to 6" bls; analyze for TCLP metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se).
- Old Fire Training Pit - JPG-030
 - o Approximately five grab surface samples should be collected from oil stained areas; analyzed for BTEX, TPH, Flash point, Halogenated Organic Compounds (HOCs), TCLP for lead and PCBs.
 - o Collect subsurface soil samples at one foot and five feet bls at approximately five locations around pit; analyze for BTEX, TPH, HOCs and TCLP for lead.
 - o Collect approximately one sample of standing water in the pit and analyze for the same parameters as the sub-surface soil samples

- Building 305 (Temporary Storage) - JPG-036
 - o Collect wipe and chip samples of interior surfaces of the building and loading ramp; analyze for PCBs, HOCs, and TCLP metals (Ba, Pb and Hg).

- EO Contamination
 - o Locate EO by geophysical means.

 - o Sample soils in area that are determined to contain EO; analyze for explosive residues such as TNT, DNT, RDX, HMX, HMS, tetryl, nitrocellulose and nitroguanidine. Screen these samples for the specified compounds using a GC scan. Analyze in detail only those that are identified in the scan. Also analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

 - o Install ground water monitoring wells if soils are shown to be contaminated.

- Yellow Sulfur Disposal Area
 - o Collect approximately 15 soil samples at depths of 0-2 ft and 2-5 ft from the area; analyze for sulfur, TCLP metals (As, Ba, Cd, Cr, Pb and Hg) and pH.
 - o Collect surface water samples from the drainage ditch; analyze for the same parameters.
- Burn Area South of New Incinerator
 - o Collect soil samples at approximately five locations; analyze samples for TCLP metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se).

5.2 PROPOSED ACTIONS SOUTH OF THE FIRING LINE (EAST SIDE)

- Open Burning Area - JPG-006
 - o Collect soil samples at 1 foot and 5 feet bls, at ten locations; analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg) and explosive residues such as TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine. These samples should be screened for the residues using a GC scan. Only those compounds

identified in the scan should be analyzed in detail and quantified.

- EO Contamination

- o Define contaminated areas by geophysical methods.
- o Sample soils in defined areas; analyze for explosive residues using GC scan for preliminary identification. The recommended parameters are TNT, DNT, RDX, HDX, HMS, tetryl, nitrocellulose and nitroguanidine. Only those compounds identified in the scan need to be analyzed in detail and quantified. Also analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

- Gator Mine Testing Area

- o Collect approximately 10 soil samples at five locations (at 0-2 ft and 2-5 ft); analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

- Burn pile at Grator Mine Testing Area

- o Collect approximately five soil samples; analyze for explosive residues using GC scan for preliminary

identification. The recommended parameters are TNT,DNT,RDX, HDX, HMS, tetryl, nitrocellulose and nitroguanidine. Only those compounds identified in the scan need to be analyzed in detail and quantified. Also analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).

5.3 PROPOSED ACTIONS IN THE FIRING LINE AREA

- Red Lead Disposal Area - JPG-009
 - o Locate the disposal areas; sample soils and surface waters, as appropriate; analyze for TCLP metals (Ba, Pb and Hg).
 - o Install ground water monitoring wells if soils are contaminated; analyze ground water for TCLP metals (Ba, Pb and Hg).
- Building 208 (Photographic Laboratory) - JPG-010
 - o Collect approximately three wipe and chip samples of each floors, and drains; analyze for total silver and cyanides.

- Building 285 (Indoor Range) - JPG-012
 - o Collect wipe samples of interior surfaces and HVAC; collect approximately 5 surface soil samples; analyze for total lead.
 - o Sample all lead bearing targets, sand traps, and other materials if present; analyze for total lead.
- Area For Munitions Demilitarization - JPG-013
 - o Locate and define the area, using geophysical methods such as ground penetrating radar or a magnetometer and trenching.
 - o Sample soils; analyze for explosive residues such as TNT, DNT, RDX, HMX, HMS, teteryl, nitrocellulose, nitroguanidine and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). Screen the samples for explosive residues using a GC scan and analyze in detail only those identified in the scan.
 - o If soils are contaminated, install ground water monitoring wells; sample ground water; analyze for the same parameters as the soil samples.

- Building 602 (Solvent Disposal Pit) - JPG-027
 - o Install approximately four shallow ground water monitoring wells; analyze ground water for VOCs. These recommendations are outlined in the Remedial Investigation Technical Report - A011, 1989.

- Building 617 (Solvent Disposal Pit) - JPG-028
 - o Install four shallow ground water monitoring wells; analyze ground water for VOCs. These recommendations are outlined in the Remedial Investigation Technical Report - A011, 1989.

- Building 279 (Solvent Disposal Pit) - JPG-029
 - o Sample ground water quarterly for one year and semi-annually for five additional years; analyze for VOCs.

 - o Evaluate need for additional wells.

- Building 105 (Temporary Storage) - JPG-031
 - o Collect wipe and chip samples from interior surfaces and HVAC; analyze for PCBs.
- Temporary Storage - JPG 032, 033
 - o Determine the locations of these areas by reviewing aerial photographs or conducting a geophysical investigation using ground penetrating radar, resistivity or conductivity meters and identify what materials were stored.
- Building 227 - Weapons Maintenance Building - JPG-034
 - o Conduct a perimeter inspection; sample areas with visible soil staining. Collect approximately four surface soil samples from around the old storage shed (Shed 11); analyze for halogenated organic compounds and heavy metals (As, Ba, Cd, Cr, Pb and Hg)
 - o Collect wipes and/or chip samples of building interior surfaces and floor drains; analyze for heavy metals (As, Ba, Cd, Cr, Pb and Hg)

- Building 186 (Vehicle Maintenance Garage) - JPG-035
 - o Conduct a site inspection; sample areas with visible soil staining.
 - o Collect approximately 5 soil samples from the building perimeter; analyze for heavy metals (As, Ba, Cd, Cr, Pb and Hg).
 - o Collect wipe and chip samples from interior surfaces and floor drains, and analyze for heavy metals (As, Ba, Cd, Cr, Pb and Hg).
- Ammunition Assembly Areas
 - o Collect wipe samples of HVAC and interior surfaces; analyze for explosives (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine) and heavy metals. A GC scan may be used to initially screen the explosives and analyze only those identified in the scan.
- Ammunition Storage Igloos
 - o Collect wipe samples of building interiors and drains if they exist; Analyze for explosives (TNT,

DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine) and heavy metals. A GC scan may be used to initially screen the explosives and analyze only those identified in the scan.

- Pesticide Storage Building
 - o Collect wipe samples of building interior surfaces and drains; analyze for pesticides
 - o Collect approximately four soil samples from around building; analyze for pesticides.

5.4 PROPOSED ACTIONS NORTH OF THE FIRING LINE

- Ordnance Disposal Site - JPG-016
 - o Collect one surface water sample; collect soil samples from four locations around the pit; analyze for explosives residues (TNT, DNT, RDX, HDX, HNS, tetryl Nitrocellulose and Nitroguanidine) and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). A GC scan may be used to scan explosive residues and only those identified in the scan need to be analyzed.

- Landfill - JPG-017
 - o Determine areal and vertical extent of landfill by geophysical means.
 - o Drill approximately four soil borings per acre. Collect soil samples at 0-2 ft and 2-5 ft and surface water samples; analyze for explosives, residues (TNT, DNT, RDX, HDX, HNS, tetryl Nitrocellulose and Nitroguanidine) and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). A GC scan may be used to scan explosive residues to select only those identified in the scan for detailed analysis.
 - o Install approximately four ground water monitoring wells, sample water; analyze for the same parameter as the soil samples; use the same approach recommended to analyze for explosive residues.
- Abandoned Well Disposal Site - JPG-018
 - o Sample water from well, analyze for the presence of explosives, TCLP metals and riot control agent and its degradation products.

- Sediment Bottom Munitions Test Pond - JPG-019
 - o Collect approximately two water samples and two sediment samples from each end of the pond; analyze for explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine), TCLP metals and herbicides.

- Asphalt Lined Test Pond - JPG-020
 - o Sample soils beneath macadam bottom and nearby surface waters; analyze for explosives, explosive by-products and TCLP metals (As, Ba, Cd, Cr, Pb, and Hg).
 - o Install ground water monitoring wells if soils are contaminated.

- Abandoned Well/Cistern Disposal Site - JPG-021
 - o Locate well/cistern.
 - o Sample soils surrounding well/cistern; analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg), explosive residues (TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine and herbicides.

Use a GC scan to identify which explosive residues are present and analyze only those present.

- o Sample water in well/cistern (if present); analyze for the same parameters as the soil samples, using the same approach while analyzing for explosive residues.
 - o Install ground water monitoring system if soils, well/cistern are contaminated. Sample ground water for same constituents.
- Explosives Burning Ground - JPG-022
- o Collect approximately 10 soil samples from 0-2 ft and 2-5 ft at 5 locations; analyze for explosive residues (TNT, DNT, RDX, HDX, HNS, tetryl Nitrocellulose and Nitroguanidine), herbicides and TCLP metals (As, Ba, Cd, Cr, Pb and Hg). A GC scan may be used to scan explosive residues and only those identified in the scan need to be analyzed.
 - o Collect surface water and sediments from down slope; collect approximately three standing surface water samples; analyze for the same parameters as the soil

samples; use the same approach recommended for explosive residues.

- Open Detonation Area - JPG-023

- o Conduct a geophysical survey using a ground penetrating radar to locate any EO present.
- o Collect soil samples at 0-2 ft and 2-5 ft intervals from ground water surface at approximately 5 locations; analyze for explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine), herbicides and TCLP metals (As, Ba, Cd, Cr, Pb, and Hg). Use a GC scan to screen the explosives and select only those identified for detailed analysis.
- o Sample seeps; analyze for the same parameters as the soil samples.
- o If the seeps are contaminated install a ground water monitoring system (approximately 10 wells, to bedrock); analyze ground water for same constituents.

- Landfills - JPG-024, 025, 026
 - o Conduct geophysical surveys to define vertical and horizontal extent of landfills.
 - o Collect soil samples at 0-2 ft and 2-5 ft from ground surface for approximately four borings/acre; analyze for TCLP metals, explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine); use a GC scan to screen the residues and select only those identified in the scan for analysis.
 - o If soil is determined to be contaminated install approximately four ground water monitoring wells at each site; collect ground water; analyze for the same parameters as the soil samples.
- EO North of the Firing Line
 - o Review available technologies for ordnance detection and removal, and their associated costs. Select six representative areas for environmental evaluation.
 - o Identify locations of all EO in these designated areas by cutting and/or burning vegetation,

conducting geophysical investigations (ground penetrating radar, conductivity meter or resistivity meter).

- o Collect surface and sub-surface soil samples from each of six representative impact areas. Analyze soils for explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine), TCLP metals and herbicides.
 - o If the soil is determined to be contaminated, initiate a groundwater investigation.
- DU Contaminated Area
- o Continue monitoring program already in place
 - o Install twelve additional monitoring wells around DU impact area; incorporate new wells into existing program.

5.5 PROPOSED ACTION FOR THE GATE 19 AREA

- Burning Ground (JPG-014) and Gate 19 Landfill
 - o Conduct geophysical survey of the area using ground penetrating radar, or conductivity or resistivity meters to determine the vertical and horizontal extent of each of these two areas.
 - o Collect soil samples at approximately 10 locations in area of burning ground; analyze for TCLP metals (As, Ba, Cd, Cr, Pb and Hg).
 - o Review the placement and installation of the current network of ground water monitoring wells for adequacy to determine off-site migration. Install additional ground water monitoring wells as appropriate at unconsolidated/consolidated materials contact and/or into shallow bedrock; analyze water for TCL parameters.
 - o Re-sample existing wells; analyze for TCL Parameters.

- o Develop a comprehensive quarterly ground water sampling program. Adjust sampling frequency/analysis schedule after two years.

5.6 PROPOSED ACTIONS FOR OTHER AREAS REQUIRING ENVIRONMENTAL EVALUATION

- PCB Containing Oils

- o Continue current PCB management programs.

- Asbestos Removal Program

- o Review the asbestos survey that was conducted for adequacy.
- o Initiate a new survey of all base buildings if necessary.
- o Continue current asbestos management procedures for removal and handling of asbestos.

- Underground Storage Tanks
 - o Conduct a site assessment where petroleum contaminated soils have been identified. Include soil and groundwater sampling (if appropriate).
 - o Undertake a program of tank testing to ensure that all the USTs are in compliance with Federal, State and local regulations.
- Surface Water
 - o Collect water and sediment from all surface water bodies, including where streams enter and exit JPG; analyze for explosive residues (TNT, DNT, RDX, HMX, HNS, tetryl, nitrocellulose and nitroguanidine), herbicides, TCLP metals (As, Ba, Cd, Cr, Pb and Hg) and pesticides.
 - o Sample monthly for two years; re-evaluate program.
- Ground Water
 - o Review well users from within a 2 mile radius from the perimeter of the installation.

- o Review the data obtained from investigation within the interior of JPG.
 - o If necessary, install a perimeter ground water monitoring system at JPG.
 - o Coordinate installation of the perimeter system with wells to be installed at SWMUs, AREE and impact areas.
 - o Analyze ground water for selected parameters on quarterly basis for two years, then re-evaluate the program. These parameters should be selected only after reviewing the data from the interior of the facility.
- Radon Gas
 - o No recommended action.
 - Lead Paint
 - o Conduct a lead paint survey in all residential buildings located at JPG.

TABLE 5.1: Summary of Sampling Recommendations

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|---|----------------------------|--------------------------|--|---|
| PROPOSED ACTIONS SOUTH OF THE FIRING LINE (WEST SIDE) | | | | |
| Old Incinerator | Soil (surface) Interior | 4 2 | TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Water Quality Laboratory | No Recommended Action | | | |
| Sewage Treatment Plant | Soil (surface) | 10 | Total silver, TCLP silver, cyanides | |
| Explosives Burning Area | Soil' | 20 | Explosives residues*, TCLP metals | Conduct geophysical survey TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Landfill | Soil | 8 | Target Compound List (TCL) parameters | Conduct geophysical survey |
| Wood Storage Pile | No Recommended Action | | | |
| Contaminated Wood Storage Pile | No Recommended Action | | | |
| New Incinerator: Building 333 | Soil (surface) Interior | 4 X | TCL parameters TCLP metals | TCL parameters: Ag, As, Ba, Cd, Cr, Pb, Hg and Se |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|------------------------------------|-----------------------|--------------------------|---|---|
| Old Fire Training Pit | Soil (surface) | 5 | BTEX, TPH, TCLP metals, Flashpoint, PCBs | TCLP parameter: Pb only |
| | Soil (sub-surface) | 10 | HOCs, BTEX, TPH and TCLP metals | TCLP parameters: Pb only |
| Temporary Storage; Building 305 | Interior | X | PCBs, HOCs and TCLP metals | TCLP parameters: Ba, Pb and Hg |
| EO Contamination | Soil | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Pb and Hg |
| Yellow Sulfur Disposal Area | Soil (surface) | 15 | Sulfur, TCLP metals pH | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water | X | Sulfur, EP Tox Metals, pH | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Burn Area South New Incinerator | Soil (surface) | 5 | TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREA/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|--|-----------------------|--------------------------|-------------------------------------|---|
| PROPOSED ACTIONS SOUTH OF THE FIRING LINE (EAST SIDE) | | | | |
| Open Burning Area | Soil (sub-surface) | 20 | TCLP metals, explosive residues* | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| EO Contamination | Soil (sub-surface) | X | Explosive residues TCLP metals | Conduct geophysical survey TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Gator Mine Testing Area | Soil (sub-surface) | 10 | TCLP metals, explosive residues* | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Burn Pile at Gator Mine Testing Area | Soil (surface) | 5 | TCLP metals, explosive residues* | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Red Lead Disposal Area | Soil | X | TCLP metals | TCLP parameters: Ba, Pb and Hg |
| | Water | X | TCLP metals | TCLP parameters: Ba, Pb and Hg |
| Photographic Lab; Building 208 | Interior | X | Total silver and cyanides | |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetraol, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|---|----------------------------|--------------------------|------------------------------------|---|
| Indoor Range | Soil (surface) Interior | 5 X | Total lead Total lead | |
| Area for Munitions Demilitarization | Soil (surface) | X | Explosive residues* TCLP metals | Conduct geophysical survey TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water | X | Explosive residues* TCLP metals | |
| Building 602 Solvent Disposal Pit | Water | 4 | VOCs | Install ground water monitoring wells: (follow recommendations in Technical Report A011) |
| Building 617 Solvent Disposal Pit | Water | 4 | VOCs | Install ground water monitoring wells: (follow recommendations in Technical Report A011) |
| Building 279 Solvent Disposal Pit | Water | X | VOCs | Sample quarterly for 1 year, and semi-annually for 4 years |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|--|----------------------------|--------------------------|----------------------------------|--|
| Building 105; Temporary Storage | Interior | X | PCBs | Identify and locate; determine materials used and stored |
| JPG 032, 033; Temporary Storage | | | | |
| Building 227; Weapons Maintenance Building | Soil (surface) Interior | X X | TCLP metals, HOCs TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Building 186 Vehicle Maintenance Garage | Soil (surface) Interior | 5 X | TCLP metals TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Ammunition Assembly Areas | Interior | X | TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Ammunition Storage Igloos | Interior | X | TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Pesticide Storage Building | Soil Interior | 4 X | Pesticides Pesticides | |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetra, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|---------------------------------|-----------------------|--------------------------|--|---|
| Explosives Burning Ground | Soil (sub-surface) | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water (surface) | X | Explosive residues*, TCLP metals | Install ground water monitoring wells |
| Ordnance Disposal Site | Soil (surface) | 4 | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water (surface) | X | Explosive residues*, TCLP metals | |
| Landfill; JPG-017 | Soil | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water | X | Explosive residues*, TCLP metals | Install ground water monitoring wells |
| Abandoned Well Disposal Site | Water | 1 | TCLP metals, riot control agent and its degradation products | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|---|-----------------------|--------------------------|---|---|
| Sediment Bottom Munitions Test Pond | Water | 4 | Explosive residues*, TCLP metals, herbicides | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Sediment | 4 | Explosive residues*, TCLP metals, herbicides | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Asphalt Lined Test Pond | Soil (surface) | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water (surface) | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Abandoned Well/ Cistern Disposal Site | Soil | X | Explosive residues*, TCLP metals, herbicides | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water | 1 | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Open Detonation Area | Soil (sub-surface) | X | Explosive residues*, TCLP metals, herbicides | Conduct geophysical survey TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|--------------------------------|-----------------------|--------------------------|---|--|
| Landfills: JPG-024 025, 026 | Water | X | Explosive residues*, TCLP metals | Conduct geophysical survey Install ground water monitoring wells |
| | Seeps | X | Explosive residues*, TCLP metals, herbicides | |
| | Soil (sub-surface) | X | Explosive residues*, TCLP metals | |
| EO North of the Firing Line | Water | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Soil | X | Explosive residues*, TCLP metals | |
| DU Contaminated | Water | X | Explosive residues*, TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water | 12 | Explosives, TCLP metals, Uranium; alpha beta, gamma | |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|---|------------------|--------------------------|------------------------------------|--|
| PROPOSED ACTION FOR THE GATE 19 AREA | | | | |
| Burning Ground (JPG-014) and Gate 19 Landfill | Soil | 10 | TCLP metals | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| | Water | X | TCL parameters | Review current well installa- tion as appropriate Install additional wells Sample wells quarterly |
| PROPOSED ACTION FOR OTHER AREAS REQUIRING ENVIRONMENTAL EVALUATION | | | | |
| PCB Containing Oils | NA | | | |
| Asbestos Removal Program | NA | | | |
| Underground Storage Tanks | Soil Gas | X | BTEX | Conduct site assessment |
| Surface Water | Water | X | Explosive residues*, herbicides | Sample quarterly |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetryl, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

TABLE 5.1: Summary of Sampling Recommendations (Continued)

| AREE/ SWMU | Sample Medium | Approximate # Samples | Analytes | Comments |
|--------------------|-----------------------|--------------------------|-----------------------------------|--|
| | Sediment | X | TCLP metals, pesticides | TCLP parameters: As, Ba, Cd, Cr, Pb and Hg |
| Ground Water | Water | X | To be determined from data review | Install a perimeter ground water monitoring system |
| Radon Gas | No Recommended Action | | | |
| Lead Paint | Interiors | X | Lead paint surveys | |
| Water Supply Wells | Water | 2 | Drinking Water Parameters | Primary and Secondary |
| | Interior Paint | X | Total Lead | |
| | Pipe Insulation | X | Asbestos | |

X: Number of samples not yet determined

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

* A GC Scan may be used to screen for explosive residues such as TNT, DNT, RDX, HDX, HNS, tetra, nitrocellulose and nitroguanidine. Only those compounds which are identified in the scan should be analyzed in detail and quantified.

- Water Supply Wells

- o Collect approximately one round of water samples from each well; analyze for primary and secondary drinking water parameters.
- o Sample the paint peeling off the basement walls of the pumping station (Buildings 150 and 152) for the wells; analyze for total lead concentration.
- o Sample the insulation material on the exhaust pipe in building which houses the pump controls (Building 154); analyze for asbestos.

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APPENDIX I

Summary Table From the JPG Enhanced Preliminary Assessment

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

South of the Firing Line (West Side)

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|---|--|-------------------|---------------------|---|--|
| | | | | Known | Suspected | | |
| Old Incinerator | JPG-001 | Used to burn paper products, debris and small ammunition from the installation | Particulate matter, fuel oil | Air | Soil | This unit is not active; no current migration pathways | Soil sampling around building |
| Water Quality Laboratory | JPG-002 | Operational at the Sewage Treatment Plant since the 1960s; laboratory analysis includes flow, pH, BOD, suspended solids, fecal coliform, and residual chlorine | Waste chemicals | | Soil | Sewer improvement programs and SOPs prevent contaminant releases | Soil sampling around the building; wipe samples of HVAC system/drains; chip sampling |
| Sewage Treatment Plant | JPG-003 | Used for the primary and secondary treatment of wastewater at the installation; sludge is dried on the sludge drying bed and disposed off post; wastewater is treated to confirm compliance with NPDES permit limitations | Liquid stream discharges and dry sludge material | | Soil, Surface water | Sampling of sludge does not indicate contamination with silver (Ag) | Soil sampling |
| Burning Ground | JPG-004 | Area once used for the open burning of explosives; dates of use unknown; currently overgrown with vegetation and not in use | TNT, DNT, heavy metals and solvents | Air | Soil | Potential migration pathway by leaching of contaminants through soils; no evidence of a release observed | Soil sampling |
| Landfill | JPG-005 | 1-acre landfill comprised of small filled-in trenches; depth unknown; used for dumping of film refuse from the photographic lab | Film (silver), solvents and lead | | Soil | Potential migration pathway by leaching of silver and solvents through soils | Geophysical screening; soil sampling to the base of the landfill |
| Wood Storage Pile | JPG-007 | Waste pile used for the storage of non-hazardous wood debris | None | | | Wood is on impermeable runway; wood is inert, non-hazardous; has no ability to migrate | |
| Contaminated Wood Storage Pile | JPG-008 | Waste pile used for the storage of PCP-contaminated wood debris | PCP | | | Wood is stored on an impermeable runway; no distressed vegetation observed; current exposure potential is low | |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

South of the Firing Line (West Side); Continued

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|---|--|-------------------|----------------------------------|--|--|
| | | | | Known | Suspected | | |
| New Incinerator | JPG-011 | Utilized to incinerate solid waste consisting of paper product, debris, and inert munitions chemical components | Contaminants in ash | Air | | The potential contaminant release mechanism is limited to air transport due to emissions from the incinerator | Soil sampling around the building |
| Fire Training Pit | JPG-030 | Unlined open pit used for fire training purposes; wood debris is soaked with used diesel fuel and POL products and Ignited | Heavy metals and petroleum products | Soil Air | | The potential contaminant release mechanisms include migration through surface soils to ground water; an oily sheen was observed; residue coating of waste POL products on soils | Soil sampling |
| Temporary Storage (Building 305) | JPG-036 | The site has been utilized since 1980 for the temporary storage of hazardous waste material prior to pick-up and removal by DRMO | Spills from stored material | | Soil | All of the wastes are properly containerized or bagged; potential for migration or dispersal is limited; no evidence of release to the environment | Soil, wipe and chip sampling |
| Explosive Ordnance (EO) Contamination | NA | The area south of the firing line potentially contains significant amounts of EO; contamination can most likely be attributed to the rocket, mine, and armor plate testing and ammunition dumping during the WWII era | Heavy metals, physical and chemical hazard | | Soil, Ground water | The potential contaminant release mechanism includes leaching of metals and High Explosive components through soils | Location of areas containing EO, soil sampling |
| Possible Sulfur Disposal Area | NA | Area used for the disposal of yellow sulfur-like material | Unknown | Soil | Surface water | The potential contaminant release mechanism includes migration of yellow material through soils, and runoff into surface water | Soil, water and sediment sampling |
| Burn Area | NA | A concrete pad and surrounding grassy area appeared to be the site of burning activity; no additional information on this area is available | Unknown | | Soil, Surface, Ground water, Air | The potential contaminant release mechanism includes migration of black residue through soils to ground water and runoff into surface water | Soil and surface water sampling |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

Page 3 of 12

| AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE | | | | | | | |
|--|---------|--|--|-------------------|-----------------------------|--|--|
| South of the Firing Line (East Side) | | | | | | | |
| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
| | | | | Known | Suspected | | |
| Open Burning Area | JPG-006 | Thermal treatment area operating under a RCRA Interim Permit; four burning trays are utilized at this site for burning of waste and unused/unusable propellant deemed unsafe to dispose with incineration | TCLP metal, explosive residue | Air | Soil | The potential contaminant release mechanisms include air transport and leaching of contaminants through soils to GW; the effectiveness of the containment device, location of the burn area, and the SOPs combine to minimize contact between waste ash and the environment; no evidence of release to soil was observed, however burning occurred here prior to installation of the trays | Soil sampling |
| EO Contamination | NA | The area south of the firing line reportedly contains significant amounts of EO; contamination can most likely be attributed to the rocket, mine, and armor plate testing and ammunition dumping during the WWII era | Heavy metals, in addition to significant physical and chemical hazards | | Soil, Ground water | The potential contaminant release mechanism includes leaching of metals through soils | Location of ordinance materials; soil sampling |
| Gator Mine Testing Area | NA | This area is used for the testing of mines | Heavy metals, explosive residues | | Soil, Surface, Ground water | The potential contaminant release mechanism includes leaching of contaminants through soils | Soil, surface and ground water sampling |
| Gator Mine Burn Area | NA | Scrap wood, wire, and plastic is periodically burned at this site | Heavy metals | | Soil Air | The potential contaminant release mechanism includes leaching of contaminants through soils | Soil sampling |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

Firing Line Area

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|--|--|-------------------|---------------------------------|---|--|
| | | | | Known | Suspected | | |
| Red Lead Disposal Area | JPG-009 | Reportedly used for the disposal of paint residuals, and lead oxides used in inert rounds; size and dates of use unknown; site location unknown | Lead | | Soil, Surface, and Ground water | Previous studies have indicated that this area is a potentially hazardous waste disposal site; potential contaminant release mechanisms are unknown | Locate the disposal area; soil, surface water, and ground water sampling |
| Photographic Laboratory | JPG-010 | Processes, develops, and prints large quantities of black and white/color film; waste toner is diluted and discharged through a floor drain to the sanitary sewer system; two silver recovery units are in place | Silver, waste toner and developer | | Soil | Heavy metals normally bond to organic material in soils and clay and do not migrate appreciably except under acidic conditions; the waste toner and developer drained into the sewer system has little migration potential; the potential for migration into ground or surface water is minimal | Wipe samples of drains, HVAC; sample soils surrounding the building; chip sampling |
| Indoor Range | JPG-012 | Utilized to test small arms for training until the early 1980s; area closed due to concern over interior contamination with lead oxides and lead dust derived from lead bullets used in the range | Lead oxides and lead dust | | Soil, Air, Building interior | The potential migration pathways include the presence of lead in soils, on interior building surfaces, and lead dust in the air | Soil sampling for lead; wipe sampling of interior surfaces; air sampling inside the building |
| Munitions Demilitarization | JPG-013 | Reportedly used for the demilitarization of munitions; size and dates of use are unknown; locations are unknown | Heavy metals, Explosive Residues (e.g. DNT, TNT) | | Soil, Ground water | Previous studies indicate that the area is a potentially hazardous waste disposal site; | Locate the disposal area; soil, surface water, and ground water sampling |
| Solvent Pit (Building 602) | JPG-027 | Utilized as a surface disposal area from 1970 to 1978 for the dumping of TCE solvent and degreaser, other unknown solvents for percolation; pit no longer used | TCE and other solvents | Soil | Ground water | TCE and other solvents have the ability to migrate, creating a high potential for ground water contamination; soil sampling indicated VOC contamination; the lateral extent of contamination is expected to be localized in the immediate vicinity; impact on ground water unknown | Install ground water monitoring wells; sample ground water |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

Firing Line Area; Continued

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|---|------------------------|--------------------|--------------|---|---|
| | | | | Known | Suspected | | |
| (Building 617) | JPG-028 | Utilized as a surface disposal area from 1970 to 1978 for dumping TCE solvent and degreaser, and other unknown solvents for percolation; pit no longer used | TCE and other solvents | Soil | Ground water | TCE and other solvents have the ability to migrate, creating a high potential for ground water contamination; soil sampling indicated VOC contamination; the lateral extent of contamination is expected to be localized in the immediate vicinity; impact on ground water unknown | Install ground water monitoring wells; sample ground water |
| Solvent Pit (Building 279) | JPG-029 | Utilized as a surface disposal area from 1970 to 1978 for the dumping of TCE solvent and degreaser, and other unknown solvents for percolation; pit no longer used | TCE and other solvents | Soil, Ground water | | TCE and other solvents have the ability to migrate creating a high potential for ground water contamination; soil sampling indicated VOC contamination; VOC contamination has been found in one downgradient well; nondetection in two wells further downgradient may indicate that no significant migration has occurred | Re-sample ground water monitoring wells; evaluate need for additional wells |
| Temporary Storage, Machine Shop (Building 105) | JPG-031 | Used since 1970s for the temporary storage of varying amounts of waste fluids such as cutting oil, cooling fluids, and naphthalenic waste fluids stored in 55 gallon drums prior to removal by DRMO | Naphthalenic oils | | Soil | No evidence of a release exists at this location; naphthalenic oils are suspected carcinogens and are considered hazardous when spent; waste fluids cannot migrate beyond the shop unless there is an uncontrolled spill in the doorway; exposure potential is low to minimal as the only hazard is to workers handling waste oil and fluid drums | Soil and chip sampling |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

Firing Line Area; Continued

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|--|------------------------|-------------------|------------------------|---|--|
| | | | | Known | Suspected | | |
| Assumed Temporary Storage | JPG-032 | Reportedly used as a storage area; size of the area, and possible source of materials are unknown | Unknown | | | The potential contaminant release mechanisms are unknown | Define and locate the site |
| Assumed Temporary Storage | JPG-033 | Reportedly used as a storage area; size of the area, and possible source materials are unknown | Unknown | | | The potential contaminant release mechanisms are unknown | Define and locate the site |
| Temporary Storage Weapons Maintenance (Building 227) | JPG-034 | Warehouse used for repairing and refurbishing gun tubes and other weapons and weapons parts; also utilized for storage of waste solvent and oil; when full, the drums are picked up by DRMO | Solvents and waste oil | | Soil | The solvents and waste oil have the potential to migrate into the shallow surface deposits and shallow ground water in the event of a spill; minor spillage has occurred during handling of the drums | Soil and chip sampling |
| Temporary Storage, Motor Pool (Building 186) | JPG-035 | Warehouse used as a maintenance garage for repairing heavy equipment and vehicles; also utilized for temporary storage of solvent, No. 1 fuel oil, undrained batteries, light/heavy scrap metal storage containers; oil separator pits | Solvents and waste oil | | Soil | The solvents and waste oil have the potential to migrate into the shallow surface deposits and shallow ground water in the event of a spill; minor spillage has occurred during handling of the drums | Sample surrounding soils |
| Ammunition Assembly Area | NA | Several buildings at JPG are utilized for assembly of munitions | Explosive residue | | Air, Building interior | Various projectiles are assembled in strict accordance with safety protocols; the possibility exists that explosive residues are present on building surfaces and HVAC systems | Wipe sampling of building surfaces and HVAC systems; Flame test of cracks and crevices |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

North of the Firing Line

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|--|-----------------------------------|-------------------|-----------------------------|--|--|
| | | | | Known | Suspected | | |
| Ordnance Disposal Site | JPG-016 | Previously utilized for disposal of munitions-related components, including chemical explosives; area consists of a water-filled pit which contains ordnance | Lead, Chromium explosive residues | | Soil Water | It is unknown if the shells are explosive or not; lead, chromium, and explosive residues have the ability to leach into the surrounding soils; physical hazards are of most concern | Soil and surface water sampling |
| Landfill | JPG-017 | Abandoned landfill of unknown depth; utilized from 1960-1981 for burial of inert munitions; burial wastewater-filled pits containing inert shells make up the 8-acre site | Metals, explosives residues | | Soil, Ground water | The metal parts may contain explosives or other hazardous constituents; metals can migrate over time; ground water is relatively shallow and may be a release pathway to the environment | Geophysics to determine the extent of the landfill, soil and ground water sampling |
| Abandoned Well Disposal | JPG-018 | Abandoned water well used for the disposal of munitions-related materials; 100-200 riot control grenades were dumped into this farm well; ammunition can be seen in the vicinity of the well | Metals, explosive residues | | Ground water | It is unknown whether the shells are explosive or not; riot control agent (CS/CN) if released will hydrolyze while ignitor/pyrotechnic mix and metals may leach into the ground water | Sample ground water |
| Munitions Test Pond | JPG-019 | Previously used sediment bottom munitions test pond; pond drained and no munitions found; pond has refilled with water | EO, metals, explosives | | Soil, Sediment, Water | It is unknown if EO is located beneath the pond; lead, chromium, explosive residues (e.g. TNT, DNT) may migrate into soils | Sample sediment, and water; geophysical survey to locate EO |
| Macadam Lined Test Pond | JPG-020 | Reported to be contaminated with munitions and the herbicide Ureabor; this pond is presently dry | EO, metals, explosive residues | | Soil, Water | It is unknown if the shells are potentially explosive; chromium and explosive residues (e.g. TNT, DNT) may leach into surrounding soils | Geophysical survey to locate EO; sample soil under and around pond |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

North of the Firing Line; Continued

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|---------|---|---|-------------------|---------------------------------|---|--|
| | | | | Known | Suspected | | |
| Abandoned Well/Cistern Disposal | JPG-021 | Abandoned water well used for the disposal of fuses, repeated attempts to locate the well/cistern have failed | Metals, explosive residues | | Ground water | It is unknown whether the fuses are explosive or not | Locate well/cistern; ground water sampling |
| Explosives Burning Ground | JPG-022 | Thermal treatment area previously used for the open burning on the ground of powdered explosives; area no longer used | Explosive Residues (e.g. TNT, DNT) metals | Air | Soil, Surface, and Ground water | Black residue present on the surface; there is no trace of open burning on the ground; the potential contaminant release mechanism is migration through soils to ground water | Soil, and surface water sampling |
| Open Detonation Area | JPG-023 | Thermal treatment area operating under a RCRA Interim Status Permit for open and above ground detonation; open burning occurs in a heavy steel mesh burning cage | Metals, explosive residues | Air | Soil | Leaching of metals, propellants, and explosives are included as potential migration pathways | Soil sampling; sampling of the seeps down slope of the detonation area |
| Landfill | JPG-024 | Abandoned landfill of unknown depth used for the disposal of solid waste from the Old Timber Lodge; waste includes putrescibles, paper and other types of solid waste | Leachate | | Soil, Ground water | The wastes buried have potential to migrate into the soils and ground water; no evidence of leachate or other releases exist at this site | Locate limits of landfill; sample soil, ground water and surface water |
| Landfill | JPG-025 | Abandoned landfill of unknown depth used for the disposal of solid waste and construction debris; waste includes putrescibles, paper and other types of solid wastes | Leachate | | Soil, Ground water | The wastes buried have potential to migrate into the soils and ground water; no evidence of leachate or other releases exist at this site | Locate limits of landfill; sample soil, ground water and surface water |
| Landfill | JPG-026 | Abandoned landfill of unknown depth used for the disposal of solid waste and construction debris; waste includes putrescibles, paper and other types of solid waste | Leachate | | Soil, Surface, Ground water | The wastes buried have potential to migrate into the soils and ground water; no evidence of leachate or other releases exist at this site | Locate limits of landfill; sample soil, ground water and surface water |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

North of the Firing Line; Continued

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|--------|--|--|-------------------|-----------------------------|--|--|
| | | | | Known | Suspected | | |
| EO Contamination | NA | The area north of the firing line contains significant amounts of EO; approximately 8600 acres have been utilized as designated impact or target areas; approximately 50,000 acres are suspected of being contaminated with EO | Metals, physical hazard; explosives hazard | | Soil, Surface, Ground water | The potential contaminant release mechanism includes migration of soils into surface and ground water; explosive hazard | Location of all ordnance materials; soil, surface and ground water sampling |
| Depleted Uranium Area | NA | More than 60,000 kg of low-level radioactive depleted uranium penetrators were fired on a 2-sq. mile area | Uranium | | Soil, Surface, Ground water | The potential contaminant release mechanism includes leaching of low-level radioactive contaminants through soils to ground water; while the DU rounds represent a radioactive hazard, uranium has not been detected in the ground water | Soil sampling and continued surface and ground water sampling |
| Forest Fires | NA | Forest fires have occurred occasionally due to explosions of test shells | Particulates | Air | Soil | These are now usually controlled burns conducted by the JPG Fire Department | Continue controlled burns to minimize the chance of an unwanted, uncontrolled burn |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

| AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE | | | | | | | Page 10 of 12 |
|--|---------|--|------------------------|-------------------|----------------------|--|---|
| Gate 19 Area | | | | | | | |
| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Recommendations | |
| | | | | Known | Suspected | | |
| Burning Ground | JPG-014 | Used for the open burning of construction debris and waste POL, and solvents; area overgrown with vegetation; aerial photographs show liquid filled trenches and mounded material during its use for the 1950s to the 1970s; reportedly the disposal site of TCE and paint | TCE and lead | Air | Soil Ground water | Though this area is no longer used for burning of any type of material, the reports of TCE and paint dumping indicate that a release to the environment may have occurred in this area; wells installed at this location have not detected contamination | Locate area, sample soils, continue to sample ground water |
| Landfill | JPG-015 | Used for disposal of construction debris and asbestos; comprised of 12 acres; reportedly the site of TCE and lead paint disposal | TCE and lead | Ground water | Soil | Hydrogeological analysis indicates that elevated levels of acetone are present; no lead or TCE were detected; no ground water contaminant plume has been detected thus far | Continue to sample existing wells; evaluate need for additional wells |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

Other Environmental Concerns

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|--------|---|------------------------------|-------------------|----------------------|---|---|
| | | | | Known | Suspected | | |
| PCB-containing Oils | NA | 252 transformers are located at JPG; analysis indicated that 7 of the transformers contained PCBs >500 ppm; upcoming change of the electrical distribution system will require the replacement of all electrical devices, including transformers, capacitors and breakers that contain PCBs | Polychlorinated Biphenyls | | | The inventory of transformers did not indicate if a release of PCB liquids had occurred; potential PCB-contaminant release mechanisms include leaks from transformers onto soils and pavement | Remove and properly dispose of PCB transformers; wipe samples of floor stains in the transformer storage area |
| Asbestos | NA | Asbestos containing materials are present in various construction materials of several buildings; a preliminary survey estimated approximately 197,000 linear feet; asbestos shingles/siding contribute an additional 258,000 square feet; an on-going asbestos removal program is in place | Asbestos fibers | Air | | The asbestos encountered were indicative of a significant amount of friable asbestos; a brief visual inspection noted that pipe lagging, and broken ceiling tiles were exposed to the natural elements of wind, heat, and water | Remove and dispose or encapsulate any asbestos material identified during an asbestos survey as presenting a threat to human health |
| Underground Storage Tanks | NA | There are 54 USTs located at various sites; the tanks were installed between 1941 and 1985; the tanks vary in size (300 and 25000 gallons) and construction (steel to coated steel); contents include No. 2 fuel and diesel oil, leaded and unleaded gasoline, kerosene and white gas | Volatile organics, lead, TPH | | Soil Ground water | Recently promulgated UST regulations require the upgrade or removal/replacement of USTs to meet specific measures for leak detection, prevention, and remediation of releases; it is unknown whether the tanks are in compliance with the new regulations; the age of the tanks create the potential for leaks to surrounding soils; JPG currently has a UST management plan which provides for UST removal | Removal and dispose of the remaining USTs according to JPG's UST management program; perform required closure assessments; develop corrective actions plans as needed |

AREAS REQUIRING ENVIRONMENTAL EVALUATION SUMMARY TABLE

Other Environmental Concerns; Continued

| Areas Requiring Environmental Evaluation | SWMU # | Description | Suspected Contaminants | Releases to Media | | Conclusions | Recommendations |
|--|--------|---|---|-------------------|---------------|--|--|
| | | | | Known | Suspected | | |
| Surface Water | NA | Several creeks traverse the proving ground; these include Otter Graham, Little Graham, Marble, Big, and Harberts Creeks | Explosive Residues (e.g. TNT, DNT) Metals | | Surface water | Potential for contaminant release to surface waters on site is high; surface waters on site may carry contaminants from off-site to JPG | Conduct surface water and sediments sampling along major streams at JPG and at the installation boundary |
| Ground Water | NA | The bedrock in the JPG area does not have dependable water-bearing strata; public/private utilities provide water service to practically all households in the small rural areas surrounding JPG; nearly all of this water is pumped from the Madison well field which yields 8.3 MGD from the sand and alluvial aquifer of the Ohio River Valley; a number of private well users are in the surrounding area | Unknown | | Ground water | Private wells could be considered as potential off-site receptors if contaminants are released via ground water flow from JPG; the regional flow appears to be in the south-south-west direction; however, geologic features alter the flow direction especially locally | Conduct ground water sampling around the perimeter of the installation, in addition to around SWMUs and AREEs as appropriate |
| Radon | NA | Radon gas is generated by the decay of uranium in the bedrock or other subsurface features; this gas can potentially exist in any of the buildings at JPG | Radon | | Air | | Conduct radon gas survey at each priority 1 building (residential, hospital and day care) |
| Lead Paint | NA | Several of the buildings at JPG were reportedly painted with lead paint | Lead | | | | Conduct lead paint survey of residential buildings |

APPENDIX II

**Parameters Included in Target Compound List (TCL)
and Toxicity Constituents Leachate Procedure (TCLP)**

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|----------------------------|-------------|-------------------------|------------------------|
| ORGANICS | | | |
| acenaphthene | X | X | X |
| acenaphthylene | X | X | X |
| acetone | A | X | |
| acetonitrile | X | | |
| acetophenone | X | | |
| 2-acetylamino- fluorene | X | | |
| acrolein | X | | X |
| acrylonitrile | X | | X |
| aldrin | X | X | X |
| 4-aminobiphenyl | X | | |
| aniline | X | (Removed) | |
| anthracene | X | X | X |
| aramite | X | | |
| Aroclor 1016 | X | X | X |
| Aroclor 1221 | X | X | X |
| Aroclor1232 | X | X | X |
| Aroclor 1242 | X | X | X |
| Aroclor 1248 | X | X | X |
| Aroclor 1254 | X | X | X |
| Aroclor 1260 | X | X | X |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE TWO

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|-------------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| benzene | X | X | X |
| benzidine | (Removed) | (Removed) | X |
| benz(a)anthracene | X | X | X |
| benzo(b)fluoranthene | X | X | X |
| benzo(k)fluoranthene | X | X | X |
| benzoic acid | (Removed) | X | |
| benzo(ghi)perylene | X | X | X |
| benzo(a)pyrene | X | X | X |
| benzyl alcohol | A | X | |
| alpha-BHC | X | X | X |
| beta-BHC | X | X | X |
| delta-BHC | X | X | X |
| gamma-BHC | X | X | X |
| bis(2-chloroethoxy)methane | X | X | X |
| bis(2-chloroethyl)ether | X | X | X |
| bis(2-chloroisopropyl)ether | X | X | X |
| bis(2-ethylhexyl)phthalate | X | X | X |
| bromodichloromethane | X | X | X |
| bromomethane | X | X | X |
| 4-bromophenyl phenyl ether | X | X | X |
| butyl benzyl phthalate | X | X | X |
| 2-sec-butyl-4,6-dinitrophenol | X | | |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE THREE

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|-----------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| carbon disulfide | X | X | |
| carbon tetrachloride | X | X | X |
| chlordan | X | X | X |
| p-chloroaniline | X | X | |
| chlorobenzene | X | X | X |
| chlorobenzilate | X | | |
| 2-chloro-1,3-butadiene | X | | |
| p-chloro-m-cresol | X | X | X |
| chlorodibromomethane | X | X | X |
| chloroethane | X | X | X |
| 2-chloroethyl vinyl ether | (Removed) | (Removed) | X |
| chloroform | X | X | X |
| chloromethane | X | X | X |
| 2-chloronaphthalene | X | X | X |
| 2-chlorophenol | X | X | X |
| 4-chlorophenyl phenyl ether | A | X | X |
| 3-chloropropene | X | | |
| chrysene | X | X | X |
| meta-cresol | X | | |
| ortho-cresol | X | X | |
| para-cresol | X | X | |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE FOUR

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|--------------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| 4,4'DDD | X | X | X |
| 4,4'DDE | X | X | X |
| 4,4'DDT | X | X | X |
| diallate | X | | |
| dibenzo(a,h)anthracene | X | X | X |
| dibenzofuran | A | X | |
| 1,2-dibromo-3-chloropropane | X | | |
| 1,2-dibromoethane | X | | |
| dibromomethane | X | | |
| di-n-butyl phthalate | X | X | X |
| m-dichlorobenzene | X | X | X |
| o-dichlorobenzene | X | X | X |
| p-dichlorobenzene | X | X | X |
| 3,3'-dichlorobenzidine | X | X | X |
| trans-1,4-dichloro-2-butene | X | | |
| dichlorodifluoromethane | X | | (Removed) |
| 1,1-dichloroethane | X | X | X |
| 1,2-dichloroethane | X | X | X |
| 1,1-dichloroethylene | X | X | X |
| trans-1,2-dichloroethylene | X | X | X |
| dichloromethane | X | X | X |
| 2,4-dichlorophenol | X | X | X |
| 2,6-dichlorophenol | X | | |
| 2,4-dichlorophenoxyacetic acid | X | | |
| 1,2-dichloropropane | X | X | X |
| cis-1,3-dichloropropene | X | X | X |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE FIVE

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|---|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| trans-1,3-dichloropropene | X | X | |
| dieldrin | X | X | X |
| diethyl phthalate | X | X | X |
| 0,0-diethyl-0-2-pyrazinyl phosphorothioate | X | | |
| dimethoate | X | | |
| p-dimethylaminoazobenzene | X | | |
| 7,12-dimethylbenz(a)anthracene | X | | |
| 3,3'-dimethylbenzidine | X | | |
| alpha, alpha-dimethyl- phenethylamine | X | | |
| 2,4-dimethylphenol | X | X | X |
| dimethyl phthalate | X | X | X |
| m-dinitrobenzene | X | | |
| 4,6-dinitro-o-cresol | X | X | X |
| 2,4-dinitrophenol | X | X | X |
| 2,4-dinitrotoluene | X | X | X |
| 2,6-dinitrotoluene | X | X | X |
| di-n-octyl phthalate | X | X | X |
| 1,4-dioxane | X | | |
| diphenylamine | X | | |
| 1,2-diphenylhydrazine | (Removed) | | X |
| di-n-propylnitrosamine | X | X | X |
| disulfoton | X | | |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE SIX

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|-----------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| endosulfan sulfate | X | X | X |
| endosulfan I (alpha) | X | X | X |
| endosulfan II (beta) | X | X | X |
| endrin | X | X | X |
| endrin aldehyde | X | (Removed) | X |
| endrin ketone | | X | |
| ethyl benzene | A | X | X |
| ethyl cyanide | X | | |
| ethyl methacrylate | X | | |
| ethyl methanesulfonate | X | | |
| famphur | X | | |
| fluoranthene | X | X | X |
| fluorene | X | X | X |
| heptachlor | X | X | X |
| heptachlor epoxide | X | X | X |
| hexachlorobenzene | X | X | X |
| hexachlorobutadiene | X | X | X |
| hexachlorocyclopentadiene | X | X | X |
| hexachlorodibenzo-p-dioxins | X | | |
| hexachlorodibenzofurans | X | | |
| hexachloroethane | X | X | X |
| hexachlorophene | X | | |
| hexachloropropene | X | | |
| 2-hexanone | A | X | |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE SEVEN

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|-----------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| indeno(1,2,3-cd)pyrene | X | X | X |
| iodomethane | X | | |
| isobutyl alcohol | X | | |
| isodrin | X | | |
| isophorone | A | X | X |
| isosaftrole | X | | |
| kepone | X | | |
| methacrylonitrile | X | | |
| methapyrilene | X | | |
| methoxychlor | X | X | |
| 3-methylcholanthrene | X | | |
| methyl ethyl ketone | X | X | |
| methyl methacrylate | X | | |
| methyl methanesulfonate | X | | |
| 2-methylnaphthalene | A | X | |
| methyl parathion | X | | |
| 4-methyl-2-pentanone | A | X | |
| naphthalene | X | X | X |
| 1,4-naphthoquinone | X | | |
| 1-naphthylamine | X | | |
| 2-naphthylamine | X | | |
| m-nitroaniline | A | X | |
| o-nitroaniline | A | X | |
| p-nitroaniline | X | X | |
| nitrobenzene | X | X | X |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE EIGHT

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|------------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| 2-nitrophenol | A | X | X |
| 4-nitrophenol | X | X | X |
| 4-nitroquinoline 1-oxide | X | | |
| N-nitrosodi-n-butylamine | X | | |
| N-nitrosodiethylamine | X | | |
| N-nitrosodimethylamine | X | (Removed) | X |
| N-nitrosodiphenylamine | X | X | X |
| N-nitrosomethylethylamine | X | | |
| N-nitrosomorpholine | X | | |
| N-nitrosopiperidine | X | | |
| N-nitrosopyrrolidine | X | | |
| 5-nitro-o-toluidine | X | | |
| parathion | X | | |
| pentachlorobenzene | X | | |
| pentachlorodibenzo-p-dioxins | X | | |
| pentachlorodibenzofurans | X | | |
| pentachloroethane | X | | |
| pentachloronitrobenzene | X | | |
| pentachlorophenol | X | X | X |
| phenacetin | X | | |
| phenanthrene | X | X | X |
| phenol | X | X | X |
| p-phenylenediamine | X | | |
| phorate | X | | |
| 2-picoline | X | | |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE NINE

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|---|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| pronamide | X | | |
| pyrene | X | X | X |
| pyridine | X | | |
| safole | X | | |
| silvex | X | | |
| styrene | A | X | |
| 2,4,5-T | X | | |
| 1,2,4,5-tetrachlorobenzene | X | | |
| 2,3,7,8-tetrachlorodibenzo- p-dioxin | X | | X |
| tetrachlorodibenzo-p-dioxins | X | | |
| tetrachlorodibenzofurans | X | | |
| 1,1,1,2-tetrachloroethane | X | | |
| 1,1,2,2-tetrachloroethane | X | X | X |
| tetrachloroethylene | X | X | X |
| 2,3,4,6-tetrachlorophenol | X | | |
| tetraethyldithiopyrophosphate | X | | |
| toluene | X | X | X |
| o-toluidene | X | | |
| toxaphene | X | X | X |
| tribromomethane | X | X | X |
| 1,2,4-trichlorobenzene | X | X | X |
| 1,1,1-trichloroethane | X | X | X |
| 1,1,2-trichloroethane | X | X | X |
| trichloroethylene | X | X | X |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE TEN

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|---------------------------------|-------------|-------------------------|------------------------|
| ORGANICS (CONTINUED) | | | |
| trichloromonofluoromethane | X | | (Removed) |
| 2,4,5-trichlorophenol | X | X | |
| 2,4,6-trichlorophenol | X | X | X |
| 1,2,3-trichloropropane | X | | |
| 0,0,0-triethyl phosphorothioate | X | | |
| sym-trinitrobenzene | X | | |
| vinyl acetate | A | X | |
| vinyl chloride | X | X | X |
| total xylenes | A | X | |
| METALS | | | |
| aluminum | (Removed) | X | |
| antimony | X | X | X |
| arsenic | X | X | X |
| barium | X | X | |
| beryllium | X | X | X |
| cadmium | X | X | X |
| calcium | (Removed) | X | |
| chromium | X | X | X |
| cobalt | A | X | |
| copper | X | X | X |
| iron | (Removed) | X | |
| lead | X | X | X |
| magnesium | (Removed) | X | |
| manganese | (Removed) | X | |

APPENDIX IX, SUPERFUND,
AND PRIORITY POLLUTANT COMPOUNDS
PAGE ELEVEN

| COMMON NAME | APPENDIX IX | SUPERFUND LIST (TCL) | PRIORITY POLLUTANTS |
|---------------------------|-------------|-------------------------|------------------------|
| METALS (CONTINUED) | | | |
| mercury | X | X | X |
| nickel | X | X | X |
| potassium | (Removed) | X | |
| selenium | X | X | X |
| silver | X | X | X |
| sodium | (Removed) | X | |
| thallium | X | X | X |
| tin | A | (Removed) | |
| vanadium | X | X | |
| zinc | X | X | X |
| MISCELLANEOUS | | | |
| cyanide | X | X | X |
| phenols | | | X |
| sulfide | X | | |

A = Added from Superfund List

TC Constituents (39) and their regulatory levels

Volatile Compounds

| | |
|----------------------|------------|
| Benzene | .5 mg/l |
| Carbon tetrachloride | .5 mg/l |
| Chlorobenzene | 100 mg/l |
| Chloroform | 6.0 mg/l |
| 1,2-dichloroethane | .5 mg/l |
| 1,1-dichloroethylene | .7 mg/l |
| Methyl Ethyl Ketone | 200.0 mg/l |
| Tetrachloroethylene | .7 mg/l |
| Trichloroethylene | .5 mg/l |
| Vinyl Chloride | .2 mg/l |

Base Neutral Acids

| | |
|--------------------------|------------|
| <u>o</u> -cresol | 200 mg/l |
| <u>m</u> -cresol | 200 mg/l |
| <u>p</u> -cresol | 200 mg/l |
| 1,4-dichlorobenzene | 7.5 mg/l |
| 2,4-dinitro-toluene | .13 mg/l |
| Hexachlorobenzene | .13 mg/l |
| Hexachloro-1,3-butadiene | .5 mg/l |
| Hexachloroethane | 3.0 mg/l |
| Nitrobenzene | 2.0 mg/l |
| Pentachlorophenol | 100 mg/l |
| Pyridine | 5.0 mg/l |
| 2,4,5-trichlorophenol | 400.0 mg/l |
| 2,4,6-trichlorophenol | 2.0 mg/l |

Pesticides

| | |
|--------------|------------|
| Chlordane | .03 mg/l |
| Endrin | .02 mg/l* |
| Heptachlor | .008 mg/l |
| Lindane | .4 mg/l* |
| Methoxychlor | 10.0 mg/l* |
| Toxaphene | .5 mg/l* |

Herbicides

| | |
|-------------------|------------|
| 2,4-D | 10.0 mg/l* |
| 2,4,5-TP (Silvex) | 1.0 mg/l* |

Metals

| | |
|----------|-------------|
| Arsenic | 5.0 mg/l* |
| Barium | 100.0 mg/l* |
| Cadmium | 1.0 mg/l* |
| Chromium | 5.0 mg/l* |
| Lead | 5.0 mg/l* |
| Mercury | .2 mg/l* |
| Selenium | 1.0 mg/l* |

The constituents noted () are the original EP Toxicity constituents.*



Environmental Fact Sheet

TOXICITY CHARACTERISTIC RULE FINALIZED

The final Toxicity Characteristic rule adds 25 organic chemicals to the eight metals and six pesticides on the existing list of constituents regulated under RCRA. The rule also establishes regulatory levels for the new organic chemicals listed, and replaces the Extraction Procedure leach test with the Toxicity Characteristic Leaching Procedure. Generators must comply with this regulation within six months of the date of notice in the Federal Register; small quantity generators must comply within one year.

BACKGROUND

On June 13, 1986, the Environmental Protection Agency (EPA) proposed to revise the existing toxicity characteristic, one of four characteristics used by the Agency to identify hazardous waste to be regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The proposed rule was designed to refine and broaden the scope of the RCRA hazardous waste regulatory program, and to fulfill specific statutory mandates under the Hazardous and Solid Waste Amendments of 1984.

Under current regulations, EPA uses two procedures to define wastes as hazardous: *listing* and *hazardous characteristics*. The listing procedure involves identifying industries or processes that produce wastes that pose hazards to human health and the environment. The second procedure involves identifying properties or "characteristics" that, if exhibited by any waste, indicate a potential hazard if the waste is not properly controlled. Toxicity is one of four characteristics that must be considered when identifying a waste as hazardous. The others are ignitability, reactivity, and corrosivity.

The proposed version of the new rule added 38 new substances to the Toxicity Characteristic list; 13 of these constituents are not included in the final version due to technical difficulties in establishing appropriate regulatory levels. EPA bases all regulatory levels for hazardous chemicals on health-based *concentration thresholds* and a *dilution/attenuation factor* specific to each chemical. A concentration threshold

indicates how much of the chemical adversely affects human health, while the dilution/attenuation factor indicates how easily the chemical could seep (or "leach") into ground water. The levels set in the Toxicity Characteristic (TC) rule were determined by multiplying the health-based number by a dilution/attenuation factor of 100.

The introduction of the TC rule in 1986 generated extensive public comment on a variety of issues. The TC involves a new "modeling" approach, a mathematical computer model, to simulate what happens to hazardous waste in a landfill. Results from the Toxicity Characteristic Leaching Procedure (TCLP), a new test that is part of the TC rule, are more reproducible than results from the old Extraction Procedure (EP) leach test, and the new test is easier to run.

Following the 1986 proposal, EPA published several supplemental notices in an effort to evaluate and incorporate public comments before finalizing the rule.

ACTION

EPA is finalizing the regulatory levels for 25 of the 38 constituents of concern that were identified in the proposed Toxicity Characteristic rule. Regulatory levels for the remaining 13 constituents will be proposed at a later date.

A waste may be a "TC waste" if any of the chemicals listed below are present in waste sample extract or leachate resulting from application of the TCLP to that waste. If chemicals are present at or above the specified regulatory levels, the waste is a "TC waste," and is subject to all RCRA hazardous waste requirements. Regulatory levels established under the EP toxicity characteristic remain the same, but require application of the new test.

Waste generators who have already notified the Agency that they generate other hazardous wastes and who have obtained an EPA identification number for their facility are not required by this rule to notify EPA that they now generate a "TC waste." Facilities that are permitted to treat, store, or dispose of hazardous waste, however, may require new or modified permits to handle "TC waste," and should contact their EPA Regional office for more information.

Implementation of the TC rule will initially be the responsibility of EPA's Regional offices. State hazardous waste programs must modify their regulations to reflect the requirements of the TC rule before they can be authorized for implementation.

The following constituents are now regulated under the Toxicity Characteristic rule. Waste generators must determine the levels present in their waste sample extract or leachate, based either on their knowledge of their processes or by application of the TCLP.

| New Constituents/Regulatory levels | Old EP Constituents/Regulatory levels |
|--|--|
| Benzene . . . 0.50 mg/l | Arsenic . . . 5.0 mg/l |
| Carbon tetrachloride . . . 0.50 mg/l | Barium . . . 100.0 mg/l |
| Chlordane . . . 0.03 mg/l | Cadmium . . . 1.0 mg/l |
| Chlorobenzene . . . 100.0 mg/l | Chromium . . . 5.0 mg/l |
| Chloroform . . . 6.0 mg/l | Lead . . . 5.0 mg/l |
| m-Cresol . . . 200.0 mg/l* | Mercury . . . 0.2 mg/l |
| o-Cresol . . . 200.0 mg/l | Selenium . . . 1.0 mg/l |
| p-Cresol . . . 200.0 mg/l | Silver . . . 5.0 mg/l |
| 1,4-Dichlorobenzene . . . 7.5 mg/l | Endrin . . . 0.02 mg/l |
| 1,2-Dichloroethane . . . 0.50 mg/l | Lindane . . . 0.4 mg/l |
| 1,1-Dichloroethylene . . . 0.70 mg/l | Methoxychlor . . . 10.0 mg/l |
| 2,4-Dinitrotoluene . . . 0.13 mg/l** | Toxaphene . . . 0.5 mg/l |
| Heptachlor (and its hydroxide) . . . 0.008 mg/l | 2,4-Dichlorophenoxyacetic acid . . 10.0 mg/l |
| Hexachloro-1,3-butadiene . . . 0.5 mg/l | 2,4,5-Trichlorophenoxypropionic acid . . . 1.0 mg/l |
| Hexachlorobenzene . . . 0.13 mg/l** | |
| Hexachloroethane . . . 3.0 mg/l | |
| Methyl ethyl ketone . . . 200.0 mg/l | |
| Nitrobenzene . . . 2.0 mg/l | |
| Pentachlorophenol . . . 100.0 mg/l*** | |
| Pyridine . . . 5.0 mg/l** | |
| Tetrachloroethylene . . . 0.7 mg/l | |
| Trichloroethylene . . . 0.5 mg/l | |
| 2,4,5-Trichlorophenol . . . 400.0 mg/l | |
| 2,4,6-Trichlorophenol . . . 2.0 mg/l | |
| Vinyl chloride . . . 0.20 mg/l | |

Many Underground Storage Tank (UST) sites are regulated under Subtitle I of RCRA. The Toxicity Characteristic rule will not apply to UST petroleum-contaminated media and debris regulated under Subtitle I until the Agency completes a number of studies of the impacts of the TC on these wastes. During the study period, UST sites will continue to be regulated under Subtitle I of RCRA.

Listed wastes, unlike characteristic wastes such as a "TC waste," can be removed from EPA's lists of hazardous wastes through a process called

- * If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol concentration is used. The regulatory level for total cresol is 200.0 mg/l.
- ** Quantitation limit is greater than the calculated regulatory level. The quantitation limit, therefore, becomes the regulatory level.
- *** The Agency will propose a new regulatory level for this constituent, based on the latest toxicity information.

delisting. Delisting determinations are made on a case-by-case, site-specific basis. Although it is not discussed in the preamble to the TC rule, the guidance for submitting delisting petitions will be modified in the near future to reflect the replacement of the EP leach test with the Toxicity Characteristic Leaching Procedure. Notification of the effective date for this change will appear in a future *Federal Register* notice.

CONCLUSION

Based on consideration of 12 affected industries, EPA estimates that the Toxicity Characteristic rule will bring a significant volume of additional wastewaters, solid waste, and sludge under the control of its hazardous waste regulations. The rule will bring a large number of waste generators under Subtitle C regulation for the first time, and many treatment, storage, and disposal facilities will require new or modified permits to handle "TC waste."

The Agency strongly encourages industry to reduce the generation of all hazardous wastes through pollution prevention and waste minimization practices. For information and publications on pollution prevention options, contact the toll-free RCRA Hotline number listed below.

TC Impact on Used Oil Regulation

Used oil that is disposed of, rather than recycled or burned for energy recovery, is regulated as a hazardous waste under Subtitle C if it exhibits any of the four characteristics described above. The Toxicity Characteristic rule adds a number of substances to the toxicity list that may bring previously "nonhazardous" used oil under Subtitle C regulation.

Currently, hazardous used oil that is recycled by being burned for energy recovery is minimally regulated under RCRA (a variety of administrative requirements must be met). Used oil that is recycled in any other way is currently exempt from Subtitle C regulation. These regulations for recycled oil are not affected by the Toxicity Characteristic rule. The Agency is currently determining how best to regulate used oil, and is working to develop standards to ensure proper management of used oil that may pose a threat to human health or the environment.

CONTACT

EPA is distributing information materials to trade associations representing those industries potentially affected by the Toxicity Characteristic rule. These materials describe constituents of concern specific to each affected industry, and include compliance guidelines for newly regulated generators. To order copies of these materials, a copy of the *Federal Register* notice, or for further information, contact the RCRA Hotline Monday through Friday, 8:30 a.m. to 7:30 p.m. EST. The national toll-free number is (800) 424-9346; for the hearing impaired, the number is TDD (800) 553-7672. In Washington, D.C., the number is (202) 382-3000 or TDD (202) 475-9652.

The U.S. Environmental Protection Agency (EPA) has developed a new rule that broadens the number of toxic wastes regulated by EPA. The new Toxicity Characteristic (TC) Rule will strengthen the hazardous waste regulatory program under the Resource Conservation and Recovery Act (RCRA), thereby providing better protection of human health and the environment. Central to this new rule is an expansion of the list of constituents that must be considered when determining whether a waste is hazardous due to its toxicity. (Toxicity is one of the four characteristics used by EPA to determine whether a waste is hazardous.) An improved test for determining potential toxicity is another important component of the new rule. As a result of these changes, more chemical waste will be determined hazardous - and more small businesses will be covered under the RCRA hazardous waste regulatory program.

WHAT is the TC Rule?

The TC Rule includes a set of regulatory levels used to determine if waste is hazardous based on its toxicity. EPA bases all regulatory levels for hazardous chemicals on health-based *concentration thresholds* and a *dilution/attenuation factor* specific for each chemical. A concentration threshold indicates how much of the chemical adversely affects human health, while the dilution/attenuation factor indicates how easily the chemical could seep into ground water, possibly contaminating drinking water supplies. The levels set in the TC rule were determined by multiplying the health-based number by a generic dilution/attenuation factor of 100. The resulting TC levels will be published in the *Code of Federal Regulations* (40 CFR 261.24). Under the new rule, companies that produce or use the constituents listed below must determine the amount of the chemical present in their waste. If testing is required, they must use a leaching test called the TCLP (Toxicity Characteristic Leaching Procedure). The TCLP is a modified form of the old Extraction Procedure (EP), and is more precise and easier to perform.

WHO is Affected by the Rule?

If a business uses any of the constituents listed below, they must determine whether the chemicals are present above the levels specified in the new regulation. If so, that waste is hazardous under the new rule, and is considered a "TC waste." Regulatory levels remain the same for the eight metals and six pesticides identified as hazardous wastes under the old EP toxicity characteristic.

What's New: Companies that produce or use the constituents listed below must determine the levels present in their waste sample extract or leachate, based either on their knowledge of their processes or by application of the TCLP.

Old EP Constituents

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver
Endrin
Lindane
Methoxychlor
Toxaphene
2,4-Dichlorophenoxyacetic acid
2,4,5-Trichlorophenoxypropionic acid

New Organic Constituents

Benzene
Carbon tetrachloride
Chlordane
Chlorobenzene
Chloroform
m-Cresol
o-Cresol
p-Cresol
1,4-Dichlorobenzene
1,2-Dichloroethane
1,1-Dichloroethylene
2,4-Dinitrotoluene
Heptachlor (and its hydroxide)
Hexachloro-1,3-butadiene
Hexachlorobenzene
Hexachloroethane
Methyl ethyl ketone
Nitrobenzene
Pentachlorophenol
Pyridine
Tetrachloroethylene
Trichloroethylene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Vinyl chloride

Generators are legally responsible for determining whether they produce hazardous wastes. Tests for any hazardous characteristic (toxicity, ignitability, reactivity, or corrosivity) can be conducted at analytical laboratories or in-house. State waste program officials can provide information on licensed laboratories. If any waste is determined to be hazardous, the generator must follow the requirements established under RCRA for the transport, treatment, storage, and disposal of hazardous waste. Under this new rule, many treatment, storage, and disposal facilities will be required to apply for new or modified RCRA permits if they accept TC waste. Generators should, therefore, be sure to work only with EPA-permitted handlers.

WHEN Does the Rule Take Effect?

EPA published the new rule on March 29, 1990. Small quantity generators (those that produce 220 to 2,200 lbs of waste in any calendar month) have one year from that date to comply; generators that produce 2,200 lbs or more in any month have six months from the date of publication to comply. Generators covered by the new rule must:

- Notify EPA that they produce a TC waste.
- Obtain an EPA ID number.
- Fill out a manifest for shipping.
- Use transporters that have EPA identification numbers.
- Use permitted treatment, storage, and disposal facilities.
- Not store the waste more than 180 days (or 270 days if the waste is being shipped more than 200 miles).

These procedures apply to all hazardous waste, whether it is considered hazardous because of its toxicity or any other hazardous characteristic.

For More Information . . .

- Call EPA's RCRA Hotline (800-424-9346, or TDD 800-553-7672 for the hearing impaired) for a copy of the *Federal Register* notice of the rule, a TC rule fact sheet, and compliance guidelines for affected industries. The Hotline answers technical and general questions regarding RCRA from 8:30 am to 7:30 pm EST, Monday through Friday excluding federal holidays.
- Ask the RCRA Hotline for *Does Your Business Produce Hazardous Waste* (EPA/530-SW-90-027). This publication provides industry-specific waste stream and waste management information. The brochure also lists state and regional hazardous waste program contacts, and advises businesses whom to call regarding additional state regulations that may apply to hazardous waste disposal. Some trade associations will also distribute the brochure.
- Call EPA's Small Business Ombudsman Hotline (800-368-5888, or 557-1938 in Washington, D.C.) for questions specific to small businesses.
- Refer to the *Code of Federal Regulations*, 40 CFR Part 261, for the applicable RCRA regulations. That section details the listed hazardous wastes, describes the hazardous characteristics, and specifies test methods to be used.

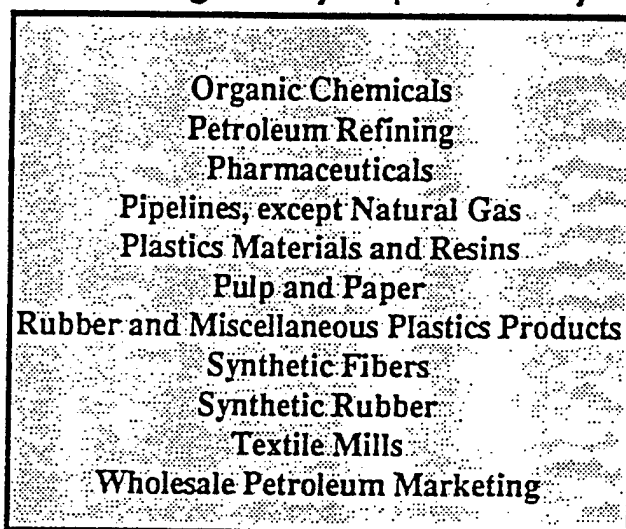
FACTS AND FIGURES ON THE TOXICITY CHARACTERISTIC (TC) RULE

What the Rule Does: Adds 25 chemicals to the eight metals and six pesticides on the existing list of constituents regulated under RCRA. The rule also establishes regulatory levels for the new organic chemicals listed, and replaces the Extraction Procedures leach test with the Toxicity Characteristic Leaching Procedure.

When It Takes Effect: Generators must comply with this regulation within six months of the date of notice in the *Federal Register*; small quantity generators must comply within one year.

Who It Affects: The rule will bring waste above regulatory levels into the system primarily from the following industries:

Major Industrial Sectors Analyzed For the Regulatory Impact Analysis



Organic Chemicals
Petroleum Refining
Pharmaceuticals
Pipelines, except Natural Gas
Plastics Materials and Resins
Pulp and Paper
Rubber and Miscellaneous Plastics Products
Synthetic Fibers
Synthetic Rubber
Textile Mills
Wholesale Petroleum Marketing

Potentially Affected Industries:

Generators: 15,000-17,000

New Treatment, Storage, and Disposal Facilities (TSDFs): 200-400, in addition to the existing 5,000 TSDFs.

Estimated Economic Savings: Approximately \$3.8 billion in damage to ground water resources avoided.

Estimated Quantity of Waste Affected: Some 1.8 million metric tons per year of nonwastewaters, which account for most of the cost, may be subject to the rule. Additionally, 700 million metric tons of wastewater may also be affected.

APPENDIX III

Analytical Results of Petroleum Contaminated Soil Samples Collected From UST Locations

ENVIRONMENTAL CONSULTANTS, INC.

Jewman Avenue • Clarksville, Indiana 47130 • Phone (812) 282-8481

**Environmental
Consultants**

Professional Laboratory Services

Laboratory Report

Date

01/16/89

Page 1 of 2

Lab Control No.

82,485 thru 82,493

P. O. Number

03-89-M-0204

Job No.

007137

e Source

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. K. Joshi

FINANCE ACCT. OFFICER

Attn: STEJP-RM-F

Madison, IN 47250-0000

Sample Description

Sample Type

Location

Soil sample

GRAB

Sample identification given below

Collected

Date Received

Collected By

Time of Collection

As noted

01/06/89

Client

00:00

meter

Results

Date Analyzed

Analyst

Method of Analysis

E.C.I. #82,485
#1, Building 602, 11-9-88
Oil and grease, pet.

721. mg/kg

01/09/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,486
#2, Bldg. 303, Airport, 11-9-88
Oil and grease, pet.

1,418. mg/kg

01/09/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,487
#3, Bldg. 310, 11-14-88 (Semi-solid)
Oil and grease, pet.

4,378. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,488
#4, Bldg. 310, 11-14-88
Oil and grease, pet.

2,593. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,489
#5, Bldg. 617, 11-17-88
Oil and grease, pet.

4,414. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

arks

ate Certification No. M-10-1

Analysis Reviewed

By

ITAL CONSULTANTS, INC.

Avenue • Clarksville, Indiana 47130 • Phone (812) 282-8481



Environmental Consultants

Professional Laboratory Services

Laboratory Report

Date

01/16/89

Page 2 of 2

Lab Control No.

82,485 thru 82,493

P. O. Number

Job No.

03-89-M-0204

007137

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. K. Joshi

FINANCE ACCT. OFFICER

Attn: STEJP-EH

Madison, IN 47250-0000

Sample Description

Sample Type

Location

Soil sample

GRAB

Sample identification given below

Collected

Date Received

Collected By

Time of Collection

As noted

01/06/89

Client

00:00

meter

Results

Date Analyzed

Analyst

Method of Analysis

E.C.I. #82,490
#6,Bldg. 617, 11-17-88
Oil and grease, pet.

648. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,491
#7,Bldg. 617, 11-17-88
Oil and grease, pet.

2,108. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,492
#8,Bldg. 291, 11-21-88
Oil and grease, pet.

2,629. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

E.C.I. #82,493
#9,Bldg. 291, 11-21-88
Oil and grease, pet.

137. mg/kg

01/10/89

Hoover

Soxhlet extraction
Gravimetric

arks

ate Certification No. M-10-1

Analysis Reviewed

By

[Signature]

ENVIRONMENTAL CONSULTANTS, INC.

Lawman Avenue • Clarksville, Indiana 47130 • Phone (812) 282-8481



**Environmental
Consultants**

Professional Laboratory Services

Source

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Laboratory Report

Date

11/07/88

Page 1 of 1

Lab Control No.

80,783

P. O. Number

Job No.

007137

FINANCE ACCT. OFFICER

Attn: STEJP-RM-F

Madison, IN 47250-0000

Sample Description

Water sample

Sample Type

GRAB

Location

Building #291

Collected

Date Received

10/28/88

Collected By

Client

Time of Collection

00:00

Parameter

Results

Date Analyzed

Analyst

Method of Analysis

Oil and grease, pet.

8.3 mg/l

11/03/88

Hoover

Partition
Gravimetric

arks

State Certification No. M-10-1

Analysis Reviewed
By

Luah Rogers

APPENDIX IV

Results of Radon Level Measurements in the Basement of JPG Building

JEFFERSON PROVING GROUND
ENVIRONMENTAL PROGRAM

RADON GAS BACKGROUND LEVEL MEASUREMENT

LABORATORY: Radon Services, Inc.
2950 Banksville Road
Pittsburgh, PA 15216 (412) 563-0553

MEASURED BY: Charcoal Cannister (Radon Gas Home Test Detector)
It is kept in basement for seven days. This detector meets
EPA Proficiency Testing.

| <u>Fam Hsg #</u> <u>(Quarters)</u> | <u>Location</u> | <u>Test Started</u> <u>Date</u> | <u>Hour</u> | <u>Test Stopped</u> <u>Date</u> | <u>Hour</u> | <u>Analysis**</u> <u>(Picocurie/Liter)</u> |
|---------------------------------------|-----------------|------------------------------------|-------------|------------------------------------|-------------|---|
| 1 | Basement | 11/15/88 | 1235 | 11/22/88 | 1343 | 1.9 |
| 3 | Basement | 11/15/88 | 1250 | 11/22/88 | 1520 | <0.5 |
| 4 | Basement | 11/15/88 | 1323 | 11/22/88 | 1432 | <0.5 |
| 7 | Basement | 11/15/88 | 1255 | 11/22/88 | 1426 | <0.5 |
| 8 | Basement | 11/15/88 | 1240 | 11/22/88 | 1347 | <0.5 |
| 11* | Basement | 11/15/88 | 1307 | 11/22/88 | 1423 | <0.5 |
| 12 | Basement | 11/15/88 | 1245 | 11/22/88 | 1351 | <0.5 |
| 15* | Basement | 11/15/88 | 1310 | 11/22/88 | 1418 | 7.2 |
| 16 | Basement | 11/15/88 | 0815 | 11/22/88 | 0815 | 0.7 |
| 17 | Basement | 11/15/88 | 1315 | 11/22/88 | 1412 | <0.5 |
| 20 | Basement | 11/16/88 | 0817 | 11/23/88 | 1000 | 0.7 |
| 21 | Basement | 11/15/88 | 1320 | 11/22/88 | 1410 | <0.5 |
| 23* | Basement | 11/15/88 | 1230 | 11/22/88 | 1403 | <0.5 |
| Bldg 112 | Basement | 11/15/88 | 1325 | 11/22/88 | 1440 | 1.6 |

*Resample. The cannister was turned into the reverse position.
Invalid Sample.

**National Average is 1 pCi/L. U.S.EPA suggested safe level is 4 pCi/L.

RADON GAS BACKGROUND LEVEL MEASUREMENT
(Continued)

| <u>Fam Hsg #</u> <u>(Quarters)</u> | <u>Location</u> | <u>Test Started</u> <u>Date</u> <u>Hour</u> | <u>Test Stopped</u> <u>Date</u> <u>Hour</u> | <u>Analysis**</u> <u>(Picocurie/L)</u> |
|---------------------------------------|-----------------|--|--|---|
| 11 | Basement | 11/23/88 1014 | 11/30/88 1500 | <0.5 |
| 15 | Basement | 11/23/88 1034 | 11/30/88 1448 | 1.7 |
| 23 | Basement | 11/23/88 1009 | 11/30/88 1454 | <0.5 |
| JPG Tunnel | #1 (North | 11/23/88 1245 | 11/30/88 1511 | <0.5 |
| | #2 End) | 11/23/88 1248 | 11/30/88 1524 | <0.5 |
| | #3 | 11/23/88 1253 | 11/30/88 1545 | <0.5 |
| | #4 | 11/23/88 1255 | 11/01/88 1425 | <0.5 |
| | #5 | 11/23/88 1300 | 11/30/88 1540 | <0.5 |
| | #6 (South | 11/23/88 1302 | 11/30/88 1538 | 1.3 |
| | End) | | | |
| Bldg 103 | #7 (Basent | 11/23/88 1312 | 11/30/88 1507 | <0.5 |
| | Boiler) | | | |

Quarters 11, 15 and 23 were resampled.

JEFFERSON PROVING GROUND
ENVIRONMENTAL PROGRAM

90 DAY SAMPLING

LABORATORY: Terradex Radon Detection Products.
Tach/Ops Laundauer, Inc.
2 Science Road
Glenwood, Illinois 60425-1586
(312) 755-7911

MEASURED BY: Radtrak Alpha Track Monitor
It is kept in basement for ninety days. This
detector meets EPA Proficiency Testing.

| <u>Serial</u> <u>Number</u> | <u>Fam Hsg #</u> <u>(Quarters)</u> | <u>Location</u> | <u>Test Start</u> <u>Date</u> | <u>Test Stop</u> <u>Date</u> | <u>Analysis**</u> <u>(Picocurie/L)</u> |
|--------------------------------|---------------------------------------|-----------------|----------------------------------|---------------------------------|---|
| 1436241 | 1 | Basement | 03/13/89 | 06/14/89 | 0.8 |
| 1436238 | 1# | Basement | 03/13/89 | 06/14/89 | 1.2 |
| 1436249 | 3 | Basement | 03/13/89 | 06/14/89 | <0.8 |
| 1436250 | 4 | Basement | 03/13/89 | 06/14/89 | <0.7 |
| 1436104 | 7 | Basement | 03/13/89 | 06/14/89 | <0.5 |
| 1436251 | 8 | Basement | 03/13/89 | 06/14/89 | <0.6 |
| 1436108 | 11 | Basement | 03/13/89 | 06/14/89 | <0.7 |
| 1436239 | 12 | Basement | 03/13/89 | 06/14/89 | <0.6 |
| 1436237 | 15 | Basement | 03/13/89 | 06/14/89 | 0.4 |
| 1436235 | 16 | Basement | 03/13/89 | 06/14/89 | 0.8 |
| 1436107 | 17 | Basement | 03/13/89 | 06/14/89 | <0.7 |
| 1436233 | 20 | Basement | 03/13/89 | 06/14/89 | 1.3 |
| 1436240 | 21 | Basement | 03/13/89 | 06/14/89 | <0.7 |
| 1436245 | 23 | Basement | 03/13/89 | 06/14/89 | <0.7 |
| 1436244 | Bldg 112 | Basement | 03/13/89 | 06/14/89 | 1.1 |
| 1436247 | Bldg 103 | Basement | 03/13/89 | 06/14/89 | 0.8 |
| 1436097 | Tunnel | West Side | 03/13/89 | 06/14/89 | 0.7 |
| 1436105 | EPA Lab | | 03/13/89 | 06/14/89 | 5.7 |
| 1489362 | B1. 108* | Office | 03/13/89 | 06/14/89 | 0.3 |
| 1489364 | B1. 108* | Office | 03/13/89 | 06/14/89 | 0.3 |

Duplicate

* Field Blanks

** National Average is 1 pCi/L. U.S. EPA suggested safe level is 4 pCi/L.

JEFFERSON PROVING GROUND
ENVIRONMENTAL PROGRAM

12 MONTH SAMPLING

LABORATORY: Terradex Radon Detection Products.
Tech/Ops Laundauer, Inc.
2 Science Road
Glenwood, Illinois 60425-1586
(312) 755-7911

MEASURED BY: Radtrak Alpha Track Monitor
It is kept in basement for one year. This
detector meets EPA Proficiency Testing.

| <u>Serial Number</u> | <u>Fam Hsg # (Quarters)</u> | <u>Location</u> | <u>Test Start Date</u> | <u>Test Stop Date</u> | <u>Analysis** (Picocurie/L)</u> |
|--------------------------|---------------------------------|-----------------|----------------------------|---------------------------|-------------------------------------|
| 1436103 | 1 | Basement | 03/13/89 | 03/13/90 | 1.0 |
| 1436236 | 1# | Basement | 03/13/89 | 03/13/90 | 0.9 |
| 1436231 | 3 | Basement | 03/13/89 | 03/13/90 | 0.4 |
| 1436106 | 4 | Basement | 03/13/89 | 03/13/90 | 0.6 |
| 1436243 | 7 | Basement | 03/13/89 | 03/14/90 | 0.4 |
| 1436099 | 8 | Basement | 03/13/89 | 03/13/90 | 0.4 |
| 1436100 | 11 | Basement | 03/13/89 | 03/13/90 | 0.3 |
| 1436246 | 12 | Basement | 03/13/89 | 03/13/90 | 0.7 |
| 1436102 | 15 | Basement | 03/13/89 | 03/13/90 | 0.4 |
| 1436111 | 16 | Basement | 03/13/89 | 03/13/90 | 0.5 |
| 1436248 | 17 | Basement | 03/13/89 | 03/13/90 | 0.7 |
| 1436101 | 20 | Basement | 03/13/89 | 03/13/90 | 1.2 |
| 1436110 | 21 | Basement | 03/13/89 | 03/13/90 | 0.4 |
| 1436230 | 23 | Basement | 03/13/89 | 03/13/90 | 0.4 |
| 1436232 | Bldg 112 | Basement | 03/13/89 | 03/13/90 | 0.9 |
| 1436098 | Bldg 103 | Basement | 03/13/89 | 03/13/90 | 0.7 |
| 1436234 | Tunnel | West Side | 03/13/89 | 03/13/90 | 0.7 |
| 1489360 | Bl. 108* | Office | 03/13/89 | 03/13/90 | <0.1 |
| 1489361 | Bl. 108* | Office | 03/13/89 | 03/13/90 | 0.3 |
| 1489356 | | Spiked | 03/13/89 | 03/13/90 | |

Duplicate

* Field Blanks

** National Average is 1 pCi/L. U.S. EPA suggested safe level is 4 pCi/L.

APPENDIX V

Details of Madison Downtown Pumpstation Wells

JEFFERSON PROVING GROUND
MADISON DOWNTOWN PUMPSTATION WELLS #1 & #2*

1. Water wells are located downtown near Madison Country Club.
2. Pumpstation is located northeast of Madison Country Club.
3. Well #1 depth 128.5 feet, rated 269 gpm.
4. Well #2 depth 131 feet, rated 271 gpm.
5. Well #1 & 2 pump tested 09 Feb 1984 (last test performed).
6. Pump #1 tested at 231 gallons per minute.
7. Pump #2 tested at 235 gallons per minute.
8. Wells were installed at the same time JPG was built.
9. Water was pumped to JPG through approximately 8 miles of 8-inch steel pipe.
10. 108,037 feet of water mains and services.
11. Approximately 205 miles of pipe on post and to Madison.
12. 35,000 gallon reservoir at the pump station.
13. Per a geological survey, the pumps were closed because of a deteriorating steel mainline from the pump station to JPG and, questionable condition of the deep wells.
14. Current status -- abandoned -- water mainline destroyed in places.
15. JPG receives city water for its drinking and industrial purposes. Cities' wells (approximately 6) are located down by the river. (Mike Wright) -- Board of Health (Ralph Armond) offpost wells.
16. Surface and groundwater north of JPG Firing Line runs to the Wabash River -- surface and groundwater south of Firing Line runs into Ohio River.



K.N. JOSHI
Environmental Engineer